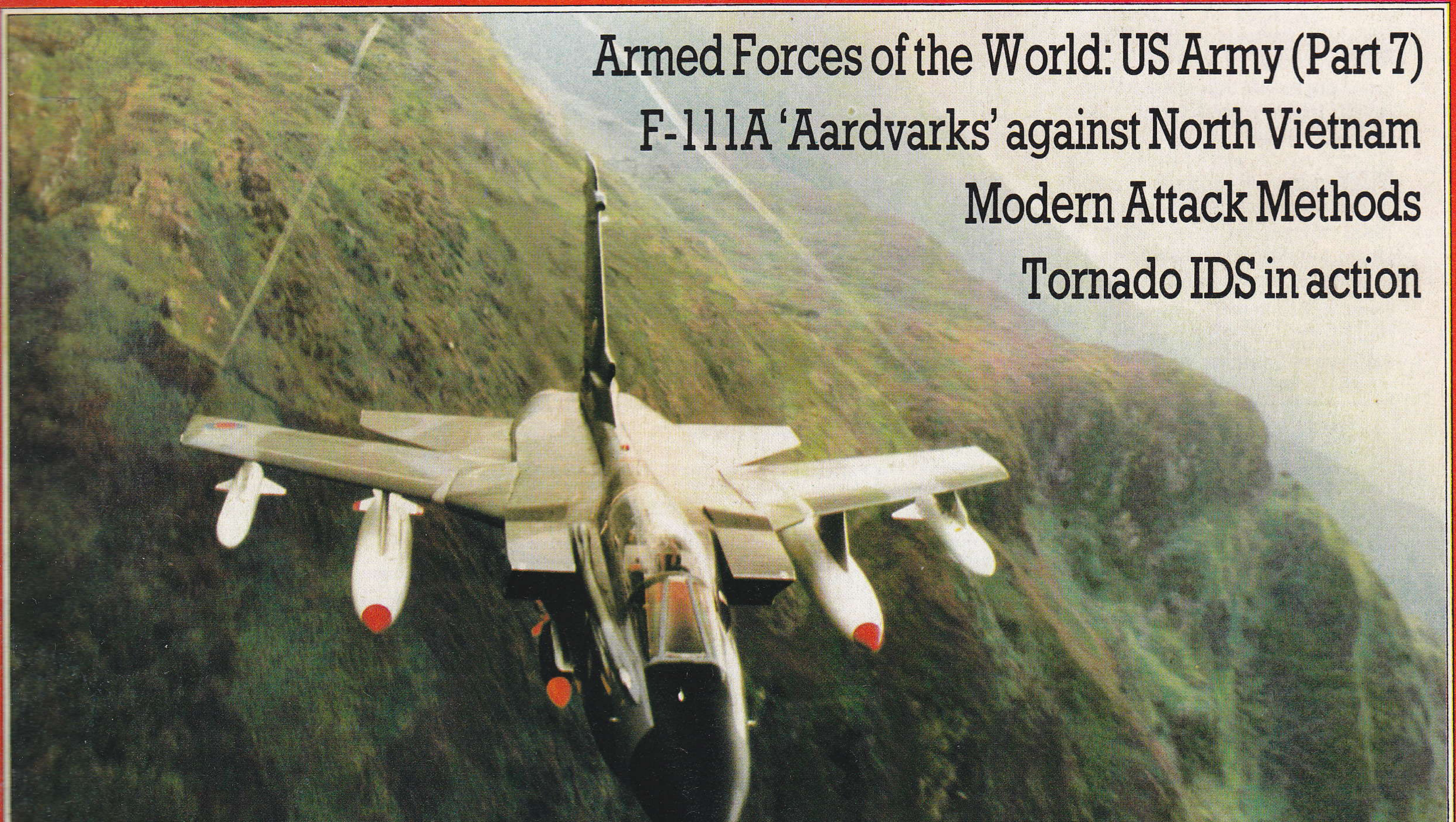
The world's most comprehensive encyclopedia of the military weapons of the 20th century

WAR MACHINE

An ORBIS Publication
80p 69
IR £1 Aus $1.95 NZ $2.25 SA R1.95 Sing $4.50 USA & Can $1.95



Armed Forces of the World: US Army (Part 7)

F-111A 'Aardvarks' against North Vietnam

Modern Attack Methods

Tornado IDS in action

A fully illustrated guide to Modern Strike Aircraft

12 AP 51

WAR MACHINE

Volume 6 **Issue 69**

Published by
Orbis Publishing Ltd

© Aerospace Publishing Ltd 1984
Colour profiles, diagrams and cutaway drawings © Pilot Press Ltd

Editorial Offices
War Machine
Aerospace Publishing Ltd
10 Barley Mow Passage
London W4 4PH

Managing Editor: Stan Morse

Editorial: Trisha Palmer
Chris Bishop
Chris Chant
Ian Drury

Design: Rod Teasdale

Colour Origination: Imago Publishing Ltd, Thame, Oxon
Typesetting: SX Composing Ltd
Film work: Precise Litho Ltd

Artists:
Keith Fretwell
Keith Woodcock

278412

Printed in Great Britain
by The Artisan Press Ltd

Subscription Manager: Christine Allen
0488 72666

Consultant Editor: Major General Sir Jeremy Moore KCB OBE MC, Commander of British Land Forces during the Falklands campaign.

Distribution and marketing offices:
Orbis Publishing Ltd
Orbis House
20-22 Bedfordbury
London WC2N 4BT
Telephone: 01-379 6711

Circulation Director: David Breed
Marketing Director: Michael Joyce

WAR MACHINE
Forthcoming issues feature:
Heavy Artillery of World War II
Modern NATO Frigates
Allied Fighters of World War II

Picture acknowledgements

Cover photograph: COI. **1361:** US Air Force/British Aerospace. **1362:** Avions Marcel Dassault-Breguet/Dassault/Bob A. Munro. **1363:** Dassault/Armée de l'Air. **1364:** COI. **1365:** COI/Grumman/Grumman/Grumman/Grumman. **1366:** British Aerospace/MoD/Panavia. **1367:** British Aerospace/Messerschmitt-Bölkow-Blohm. **1368:** COI. **1369:** MoD. **1372:** International Defence Review. **1373:** US Department of Defense/US Navy. **1374:** Flygvapen. **1375:** US Air Force/US Air Force. **1376:** US Air Force. **1377:** US Air Force. **1378:** US Air Force/US Air Force. **1379:** US Air Force. **1380:** Saab-Bofors/Flygvapen. **(iii):** US Army. **(iv):** US Army.

HOW TO OBTAIN ISSUES AND BINDERS FOR WAR MACHINE

Issues can be obtained by placing an order with your newsagent or direct from our Subscription Department. If you have difficulty obtaining any back issues from your newsagent, please write to us stating the issue(s) required and enclosing a cheque for the cover price of the issue(s).

AUSTRALIA please write to: Gordon and Gotch (Aus) Ltd, 114 William Street, PO Box 767G, Melbourne, Victoria 3001. MALTA, NEW ZEALAND, SINGAPORE & SOUTH AFRICA: Back numbers are available at cover price from your newsagent. In case of difficulty, write to the address given for binders.

UK/EIRE
PRICE: 80p/IR£1
SUBSCRIPTION:
6 Months: £23.92
1 Year: £47.84
BINDER: Please send £3.95 per binder, or take advantage of our special offer in early issues.

EUROPE
PRICE: 80p
SUBSCRIPTION:
6 Months air: £42.12
surface: £33.54
1 Year air: £84.24
surface: £67.08
BINDER: £5.00
AIRMAIL: £5.50

MALTA
Obtain BINDERS from your newsagent or Miller (Malta) Ltd, MA Vassalli Street, Valetta, Malta
Price: £3.95

MIDDLE EAST
PRICE: 80p
SUBSCRIPTION:
6 Months air: £44.98
surface: £42.12
1 Year air: £89.96
surface: £84.24
BINDER: £5.50
AIRMAIL: £8.30

AMERICAS/ASIA/AFRICA
PRICE: US$1.95/80p
SUBSCRIPTION:
6 Months air: £53.30
surface: £42.12
1 Year air: £106.60
surface: £84.24
BINDER: £5.50
AIRMAIL: £9.50

SOUTH AFRICA
PRICE: R2.35
Obtain BINDERS from any branch of Central News Agency or Intermag, PO Box 57394, Springfield 2137

SINGAPORE
PRICE: Sing$2
Obtain BINDERS from MPH Distributors
601 Sims Drive
03-07-21
Singapore 1438

AUSTRALIA/FAR EAST
PRICE: 80p
SUBSCRIPTION:
6 Months air: £57.46
surface: £42.12
1 Year air: £114.92
surface: £84.24
BINDER: £5.50
AIRMAIL: £10.00

AUSTRALIA
PRICE: AUS$2.25
Obtain BINDERS from
First Post Pty Ltd,
23 Chandos Street
St Leonards,
NSW 2065

NEW ZEALAND
PRICE: NZ$2.80
Obtain BINDERS from your newsagent or Gordon & Gotch (NZ) Ltd, PO Box 1595, Wellington

ADDRESS FOR BINDERS AND BACK ISSUES
Orbis Publishing Limited
Orbis House
20-22 Bedfordbury
London
WC2N 4BT
Telephone: 01-379-5211

Cheques/Postal Orders should be made payable to Orbis Publishing Limited. Binder prices include postage and packing and prices are in sterling.

Back Issues are sold at the cover price, and we do not charge carriage in the UK.

NOTE
Binders and back issues are obtainable subject to availability of stocks. Whilst every attempt is made to keep the price of the issues and binders constant, the publishers reserve the right to increase the stated prices at any time when circumstances dictate. Binders depicted in this publication are those produced for the UK and Australian markets only. Binders and Issues may be subject to import duty and/or local taxes, which are not included in the above prices unless stated.

ADDRESS FOR SUBSCRIPTIONS
Orbis Publishing Limited
Hurst Farm
Baydon Road
Lambourne Woodlands
Newbury
Berks
RG16 7TW
Telephone: 0488-72666

All cheques/Postal Orders should be made payable to Orbis Publishing Limited. Postage and packaging is included in subscription rates, and prices are given in Sterling.

Modern Strike Aircraft

Modern electronic defence systems are designed to let nothing through, and certainly not a big piloted aircraft. How can attack aircraft survive in any future all-out war? An extremely important element in the modern battlefield is the deep strike behind enemy lines, designed to hamper the movement of forces and to cut communications.

FB-111As of USAF Strategic Air Command are air refuelled on missions essentially strategic in nature. The Soviet Su-24 has similar capability.

More than 30 years ago air staffs in several countries had recognized that, to penetrate defended airspace, attacking aircraft would have to fly as low as possible. The UK issued far-sighted specifications for low-level bombers, but failed to get any actually built. When the nation at last built such an aircraft, the Blackburn Buccaneer, it was for the Royal Navy, and for this and other reasons the RAF steadfastly set its sights on Mach 2. Such a speed can be reached only at great heights, where no manned aircraft can survive except in airspace devoid of modern defences.

The penny keeps dropping, and though some manufacturers still insist on designing for Mach 2, which means high costs and a very compromised aircraft unsuited to the true low-level attack mission, a few are at last trying to 'get their act together'. In general today's attack aircraft have maximum speeds well below that of sound, especially when they are cluttered with a heavy external bombload. The Buccaneer, scorned for its slow maximum speed, can actually fly for long distances at treetop height with a 4,000-lb (1814-kg) bombload at speeds higher than any of its supersonic rivals, and with less than half the fuel consumption!

The Vought A-7 Corsair II, McDonnell Douglas A-4 Skyhawk and Grumman A-6 Intruder are all important attack types serving in large numbers despite the fact that they find it hard to deliver their ordnance at speeds much beyond 460 mph (740 km/h). The specialized close-support and anti-armour machines such as the Fairchild Republic A-10 and Sukhoi Su-25 are much slower still, while the Italian/Brazilian AMX is only just getting into its flight-test programme. At the upper end of the scale of size and cost, the monster Rockwell B-1 was designed for Mach 2 (at high level, where it dare not go) and for the past 10 years has been made slower and slower as the USAF tries to get the design right.

To survive, an attacking aircraft today needs stealth quality. If the enemy does not detect its presence, the aeroplane will not be shot down; conversely, if it is detected, it will be shot down no matter how fast it flies. Obviously, in the absence of stealth, a very poor second-best is to load the aircraft up with the most comprehensive electronic systems for detecting hostile illuminating radars or oncoming missiles or other threats, and fast-reacting countermeasure systems operating at radar, infra-red or optical wavelengths to try to defeat each threat as fast as it materializes.

The higher a target is in the air, the easier it is for defending radar systems to spot; at low level, interference from other targets can provide protection. The modern strike aircraft is therefore designed to fly very low and very fast, as demonstrated by this Omani Jaguar.

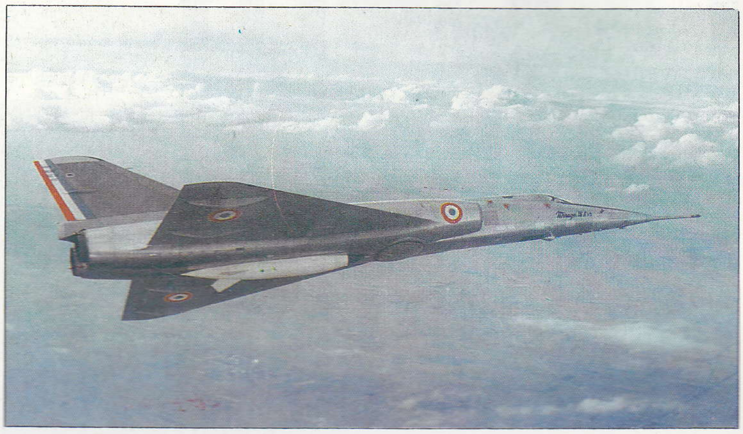
FRANCE

Dassault Mirage IVA

When France decided to create its nuclear deterrent in 1954 the size of aircraft needed was almost that of the B-58, with two afterburning J75 engines. Finally the bold decision was taken to build a smaller supersonic bomber, unable to fly a return trip but relying heavily on inflight-refuelling from a force of 14 Boeing C-135F tankers. The **Dassault Mirage IVA** was thus designed around two of the existing Atar engines, with an airframe derived from an unbuilt night-fighter similar to a scaled-up Mirage III. The slim fuselage has a refuelling probe in the nose, pilot and navigator/systems operator in tandem Martin-Baker BM4 seats, a mapping radar with a circular radome bulge just ahead of the recess for the bomb, and engine ducts with inlets similar to the half-cone centrebody type of the Mirage III. Bogie main gears with non-skid brakes and large tail parachutes assist recovery at short airbases in friendly territory. Dassault built 62 from 1963, a 1970s modification being addition of wing hard-points for heavy conventional bombloads. Today the 91^e and 94^e Escadres of the Armée de l'Air deploy five small squadrons (each normally with two pairs, one of each pair being a buddy tanker) dispersed among six primary and many secondary bases to avoid being caught on the ground. Another 12 aircraft are multi-sensor reconnaissance platforms.

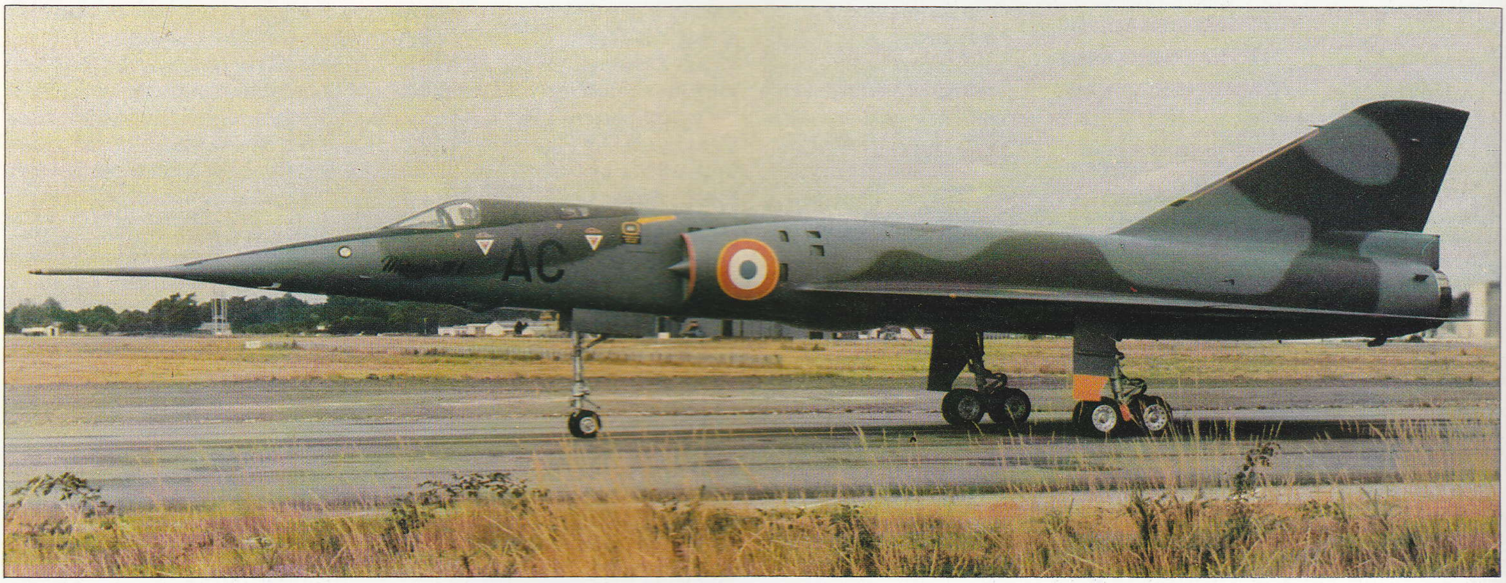
Specification

Dassault Mirage IVA
Type: supersonic bomber
Powerplant: two 7000-kg (15,432-lb) thrust SNECMA Atar 9K afterburning turbojets
Performance: maximum speed (brief dash at high altitude) 2340 km/h (1,454 mph); sustained speed 1966 km/h (1,222 mph) at 18290 m (60,000 ft); radius in the nuclear role with 12190 m (40,000 ft) cruise 1240 km (770 miles); ferry range 4000 km (2,485 miles)
Weights: empty 14500 kg (31,967 lb); maximum take-off 33475 kg (73,800 lb)
Dimensions: span 11.85 m (38 ft 10.5 in); length 23.5 m (77 ft 1 in); height 5.40 m (17 ft 8.5 in); wing area 78.0 m^2 (839.6 sq ft)



Above: The original weapon of the IVA was the 65-kilotonne AN 22 nuclear bomb seen here recessed into the belly. Some IVAs retain this weapon, but with a quick-retard system added for use in the low-level role. Other aircraft have been equipped to carry HE bombs.

Below: All Mirage IVA bombers are camouflaged. A total of 18 are to be rebuilt for service until 1996 carrying the long-range ASMP nuclear missile of 100-150 kilotonnes yield (seen on the facing page carried by the short-range Mirage 2000N).



FRANCE

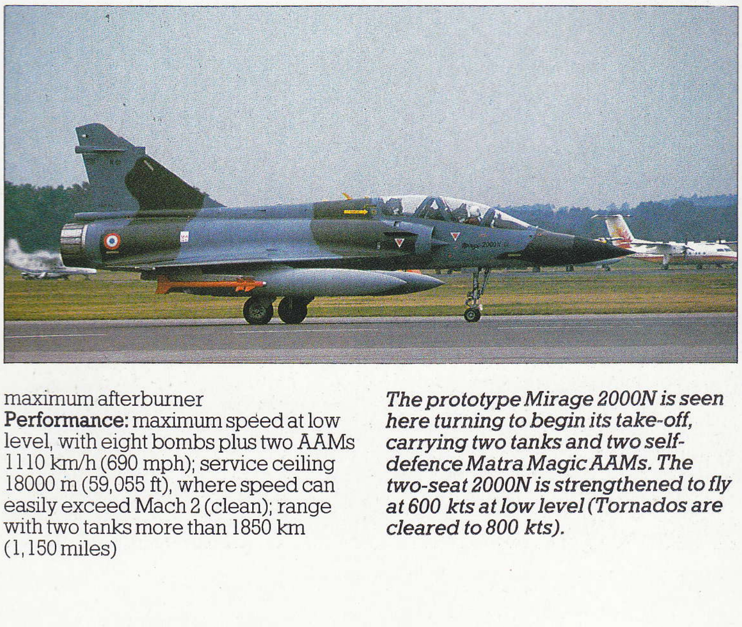
Dassault-Breguet Mirage 2000N

Though externally similar in appearance to the original Mirage III of 1956, the **Dassault-Breguet Mirage 2000** is a totally new aircraft. In structure, aerodynamic design, flight-control system, radar, engine, cockpit and weapons it represents an enormous advance over all previous Mirages, and in particular marks a rejection of the costly multi-role formula previously attempted in Dassault's ACF (Avion de Combat Futur). The ACF was abandoned in 1975, when work on the Mirage 2000 began, and the first Mirage 2000 flew on 10 March 1978. All current production is of the basic Mirage 2000C1 fighter which entered service at Creil in June 1984.

Subsequently Dassault-Breguet was given a contract to develop the **Mirage 2000N** (N for *nucléaire*) to replace the Mirage IIIE in air-to-surface attack roles. Though inevitably a fixed-geometry aircraft with a large delta wing is the wrong shape for full-throttle attack at sea level, the Mirage 2000N is restressed to fly at speeds up to 1110 km/h (690 mph) at treetop height, though the rough ride would certainly affect crew efficiency. Two crew are carried, cutting slightly into fuselage tankage, the navigator having extra displays fed by the new Thomson-CSF/ESD Antilope V radar which has a terrain-following mode. Other new equipment includes twin inertial platforms and augmented ECM installations. The first prototype Mirage 2000N flew on 3 February 1983. In service with the Armée de l'Air from early 1987, this version will normally fly with two 1700-litre (374-Imp gal) drop tanks, carrying the ASMP standoff nuclear missile. Other loads are possible for tactical use, as listed below.

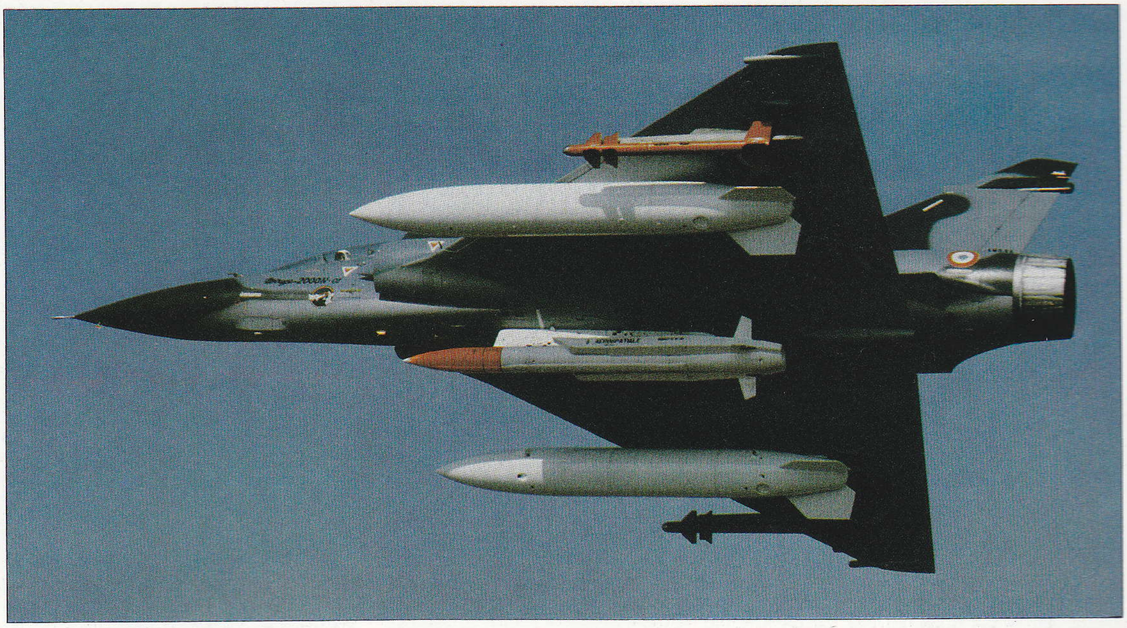
Specification

Dassault-Breguet Mirage 2000N
Type: two-seat attack bomber
Powerplant: one SNECMA M53-5 afterburning bypass turbojet rated at 9000-kg (19,842-lb) thrust with maximum afterburner
Performance: maximum speed at low level, with eight bombs plus two AAMs 1110 km/h (690 mph); service ceiling 18000 m (59,055 ft), where speed can easily exceed Mach 2 (clean); range with two tanks more than 1850 km (1,150 miles)



The prototype Mirage 2000N is seen here turning to begin its take-off, carrying two tanks and two self-defence Matra Magic AAMs. The two-seat 2000N is strengthened to fly at 600 kts at low level (Tornados are cleared to 800 kts).

Weights: empty (basic Mirage 2000 fighter) 7400 kg (16,314 lb); maximum take-off (fighter) 16500 kg (36,376 lb)
Dimensions: span 9.00 m (29 ft 6.3 in); length 14.55 m (47 ft 9 in); height not stated; wing area 41.0 m^2 (441.3 sq ft)
Armament: pylons under fuselage and wings for theoretical maximum load of 6000 kg (13,228 lb) of various bombs, rockets or missiles including Exocet, AS.30 Laser, Durandal or Belouga; primary weapon will be a single ASMP ramjet-propelled standoff nuclear attack missile; in all cases two Magic AAMs can be carried on the outer wing pylons for self-defence



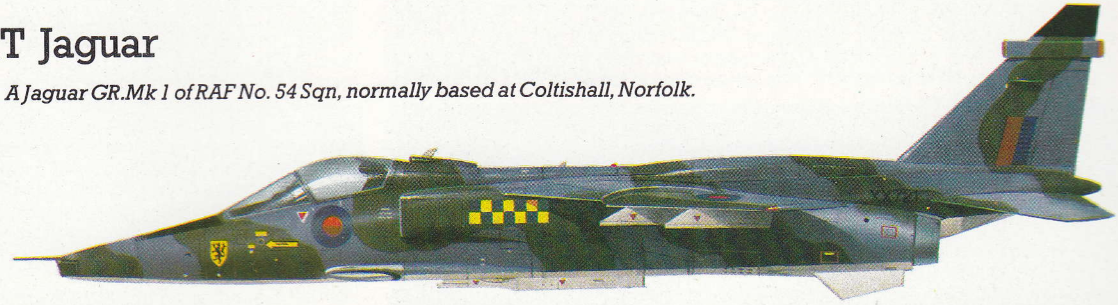
A Mirage 2000N prototype carries a dummy ASMP as well as two tanks and Magic AAMs. With a yield of 100-150 kilotonnes, ASMP will fly up to 62 miles (100 km) lifted by the projecting inlet ducts to its ramjet engine.

UK/FRANCE

SEPECAT Jaguar

Developed jointly by BAC (now BAe) and Breguet (now Dassault-Breguet), who formed the consortium to manage the programme, the **SEPECAT Jaguar** was created to meet a need by the RAF and Armée de l'Air for a low-level all-weather attack aircraft and, especially for the latter buyer, advanced jet and weapons training. Slightly different versions were produced, with one or two seats, for the two original customers, and 403 aircraft of these basic four sub-types were delivered. Export sales have been the responsibility of the UK partner (often in head-on competition with the French partner) and have so far taken sales beyond 550. The **Jaguar International** has more powerful engines and is available with radar and other sensors, Magic AAMs and certain aerodynamic improvements which enhance air-to-air and anti-ship capability as well as giving true all-weather avionics. Orders worth £108 million were flown out to Oman and Ecuador, and Oman has placed a repeat order. India placed an order which in full will be worth over £1 billion. A substantial sale has been made to Nigeria. All versions have complete ability to operate from short grass airstrips or any good section of highway. Not least of the good results achieved has been a level of maintenance man-hours roughly one-third that demanded by previous combat aircraft.

A Jaguar GR.Mk 1 of RAF No. 54 Sqn, normally based at Coltishall, Norfolk.



Specification

SEPECAT Jaguar International
Type: multi-role tactical attack fighter
Powerplant: two 3810-kg (8,400-lb) thrust Rolls-Royce Turboméca Adour Mk 811 afterburning turbofans
Performance: maximum speed at high altitude 1750 km/h (1,087 mph), and at low altitude 1350 km/h (839 mph); attack radius on a lo-lo-lo mission 917 km (570 miles)
Weights: empty 7000 kg (15,432 lb); maximum take-off 15700 kg (34,612 lb)
Dimensions: span 8.69 m (28 ft 6 in); length excluding probe 15.52 m (50 ft 11 in); height 4.89 m (16 ft 0.5 in); wing area 24.18 m^2 (260.27 sq ft)
Armament: two 30-mm Aden or DEFA cannon; seven hardpoints plus two overwing AAM pylons for total of 4763 kg (10,500 lb) of varied stores

French Jaguars have a different equipment fit from those of the RAF; this example comes from EC 11 at Toul-Rosières.

Modern Attack Methods

Modern air defence provides a formidable barrier to attacking aircraft, with sophisticated radars in the air and on the ground providing detection and guidance to ever more capable defending aircraft, missiles and guns. Such defences must be penetrated if success in battle is to be attained.

For more than 30 years it has been accepted that the best, and perhaps only, way for an attacking aircraft to penetrate defended airspace is to fly at the lowest possible height above the ground. For reasons of simple straight-line geometry, the lower the height, the more difficult it will be for defending radars to detect and lock-on to the enemy aircraft, and the greater will be the likelihood of the radar breaking lock at the crucial moment because of an obstruction (a grove of trees or some buildings, perhaps) getting in the way and confusing the radar with a different set of ranges and relative velocities.

Thus, in addition to all the other essentials, a modern attack aircraft needs aerodynamics and propulsion tailored to the sea-level atmosphere. It needs the smallest possible wing, and in particular the smallest possible span, if the ride is not to be so rough that the ability of the pilot (and backseater if present) to do his job is seriously degraded. And, in addition to all the other navaids (which are today centred on inertial systems, because these do not emit tell-tale radiation) the aircraft needs a good forward-looking radar, a TFR (terrain-following radar) and precise radar altimeter. The altimeter does not follow tradition and measure barometric pressure but instead bounces radar signals off the Earth directly beneath the aircraft and by measuring the time taken for the round trip indicates the true height above the ground. Thus, flying over a tall building would give a sudden 'hiccup' to the reading. The radar altimeter could not prevent the aircraft flying into a tall building, but the TFR could. By projecting a beam or beams diagonally ahead it guards the aircraft with a kind of invisible shape like the front of a ski continuously projected ahead. Should the invisible toe of the ski meet a mountain, building or other obstruction it commands the autopilot to lift the aircraft safely over it, though (as in the case of a tall radio mast) the best answer may sometimes be to go round it. This can be done in fog or at night, and it needs a steely-nerved flight crew.

The main forward-looking radar can be operated in many 'modes' giving different forms of picture calculated to help the crew find its way, locate targets and attack them. Radars are the most widely used of all electromagnetic sensors, but it is possible to choose quite different electromagnetic wavelengths. Making the radiation wavelength much shorter can bring it into the IR (infra-red) region, more commonly called heat. IR devices can be purely passive, able to detect and track the source of any strong IR emission, such as the jet nozzles of an enemy aircraft. Sensitive IR seekers can even lock-on to the cooler parts of an aircraft, even from head-on, and so they are used for many anti-aircraft missiles, both AAMs (air-to-air missiles) and SAMs (surface-to-air missiles). Conversely, the aircraft can use a FLIR (forward-looking infra-red) to detect targets ahead that are at a different temperature from their surroundings. Cockpit displays can show a detailed picture of the terrain ahead, or a ship at sea, with a line-by-line composition looking just like a monochrome TV. Hot areas are usually white and very cold places black, the picture thus being made up of intermediate grey tones; but the polarity can be switched the other way, for example to show a black ship on a cold grey sea. Making the wavelength even shorter brings the emission down near to visible light, and here the laser is useful. A forward-looking laser can give extremely precise ranges to a target, and this is vital for accurate weapon delivery.

An example of a complete add-on navigation and targeting system is LANTIRN, a US product packaged into two pods clipped on externally. The navigation pod contains a small TFR which can be coupled through the autopilot but is normally used merely to display the scene ahead so that the pilot can follow the ground contours manually (a dangerous procedure). It also has a FLIR with a wide FOV (field of view) which displays the 'heat picture' on the HUD (head-up display) in front of the pilot, so that he can see the picture whilst at the same time looking through the HUD to the real scene ahead. The companion targeting pod contains a narrow-FOV FLIR, a target designating and ranging laser and automatic arrangements for locking-on and tracking a chosen target. Lasers can be used to 'designate' a target by illuminating it with their special light. If a missile is launched with a seeker matched to that particular light, it will home on to its source and thus hit the target. If friendly troops are present on the ground one of them can use a laser to designate an enemy tank, fortification or other target; it can then be destroyed by a heavy missile from an aircraft fitted with a laser receiver matched to that particular laser's emissions.

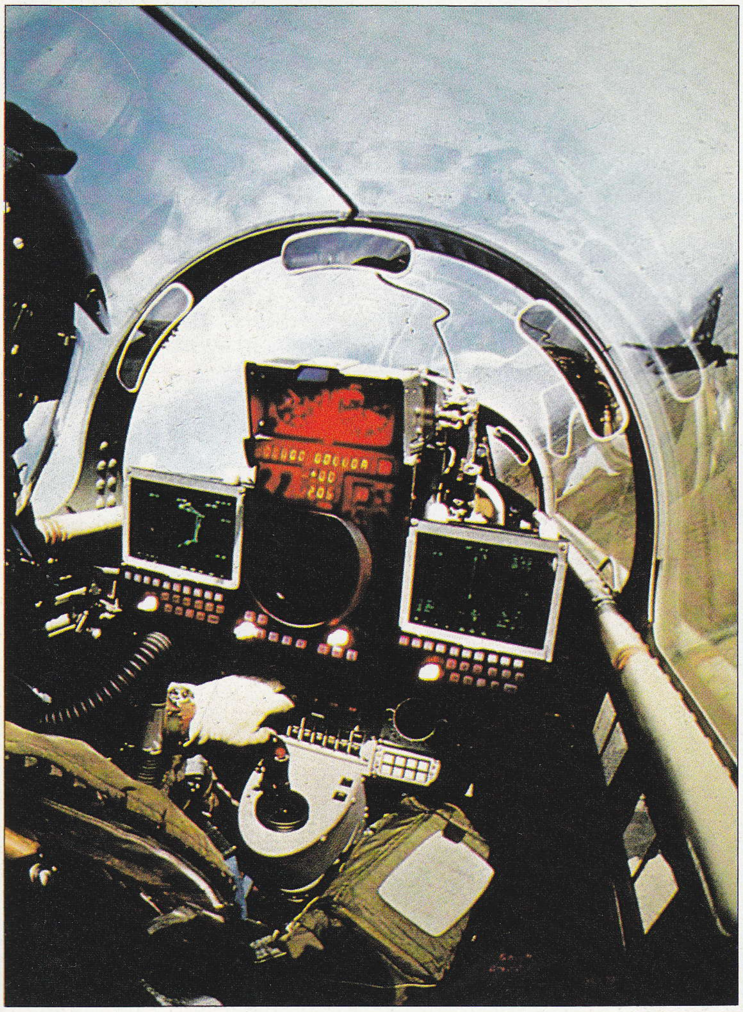
Of course, radars, IR and lasers can equally be used to shoot down the attacking aircraft. The answer is to equip the aircraft with appropriate ECM (electronic countermeasures), IRCM (infra-red countermeasures) and OCM (optical countermeasures). First, some device must be carried to warn that hostile defence systems are in use and have locked-on to an aircraft. Then an appropriate defence system must be brought into action. This is best done automatically, with computer control, not only to relieve the pilot of constant workload but also because of the speed of reaction needed. Computers are also needed to determine the exact direction and type of enemy system being used, to code the wavelength(s) of our own responses and to send out radiation in the correct direction to minimize wastage of onboard power. Enemy radars can be masked or confused by a powerful jammer built into the aircraft or carried in an attached pod. Alternatively small jammers can be dispensed in little packages fired from tubes in or carried on the aircraft. So too can hot flare payloads dispensed from similar tubes, to confuse and decoy IR-homing missiles. By far the commonest form of ECM is chaff, which fills the sky with small reflective slivers to blanket the enemy radar displays completely.

At RAF Honington a Tornado GR.Mk 1 of No. 9 Sqn is armed for a training mission. The Tornado is designed to be used at low level, its small wing and strong construction allowing very high speeds to be maintained while giving its crews a stable platform for weapons delivery.

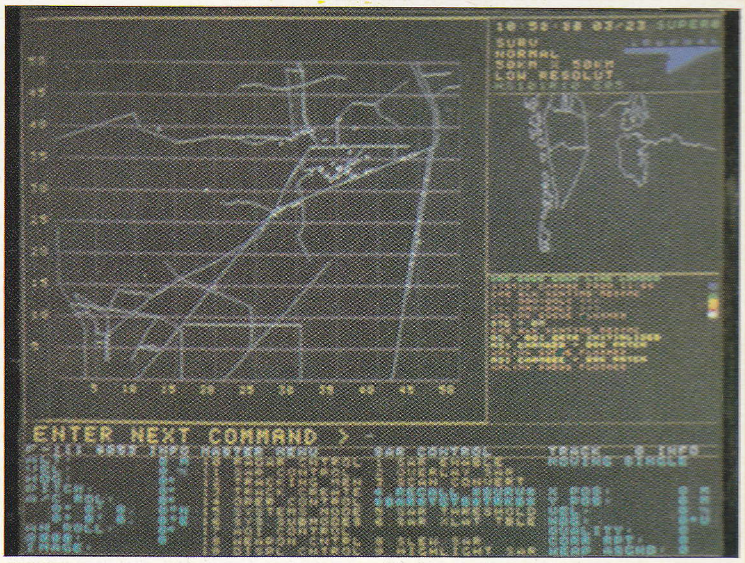
00
AQ
12
00
AQ
19

Above: A normal television image of a simulated convoy on the battlefield training zone of Nellis AFB, Utah. A purely visual attack would have to be carried out in seconds, with consequent risk of inaccuracy.

Below: A navigator's-eye view of a Tornado cockpit. Modern computerized systems have substantially lessened the workload in navigation, targeting and weapon delivery, and the Tornado can be flown at low levels in all weather.



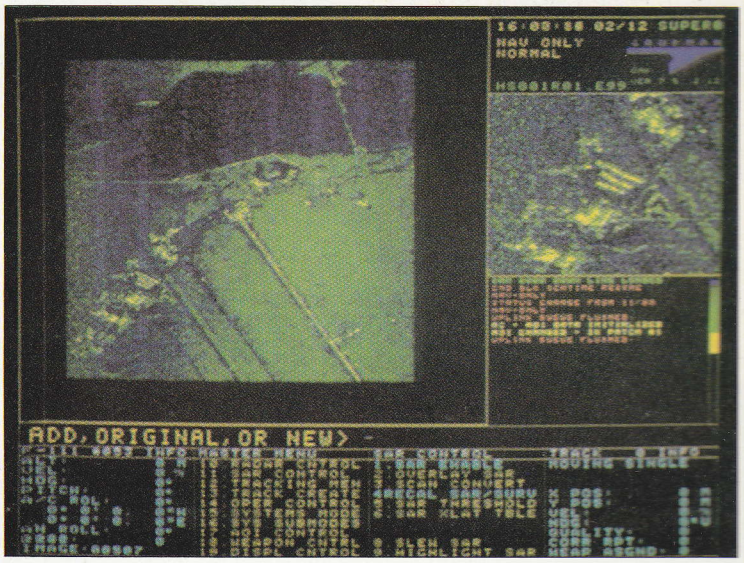
Right: Final attack run and weapon delivery is automatic, with the system protecting itself against enemy ECM (electronic countermeasures). Bad weather or night is no deterrent to the modern aircraft; indeed, a crew might never even see the target they had destroyed or the ground over which they flew.



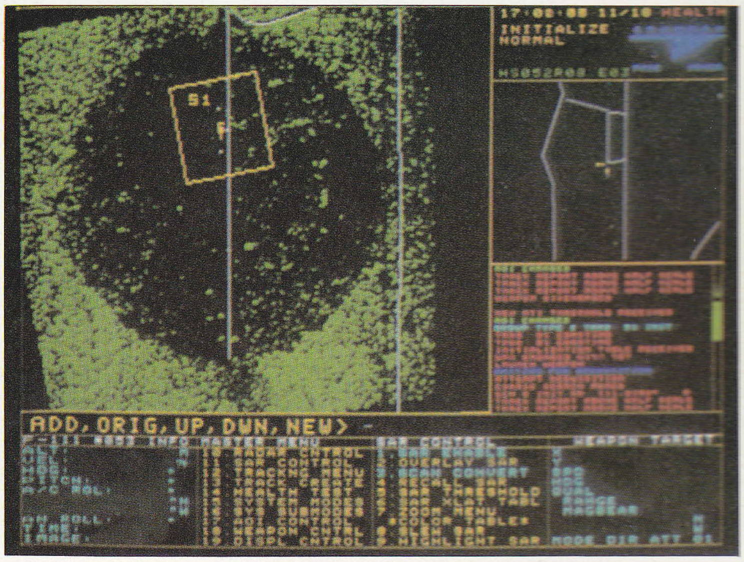
ENTER NEXT COMMAND > -

Above: In wide-area surveillance mode, the Pave Mover system enables an attacking aircraft, penetrating enemy defences at low level, to acquire and classify a range of targets as well as select appropriate weaponry.

Below: The SAR (Synthetic Aperture Radar) has a high resolution mode which enhances the detection of individual slow-moving targets. Modern systems can distinguish such targets even in conditions of background clutter.



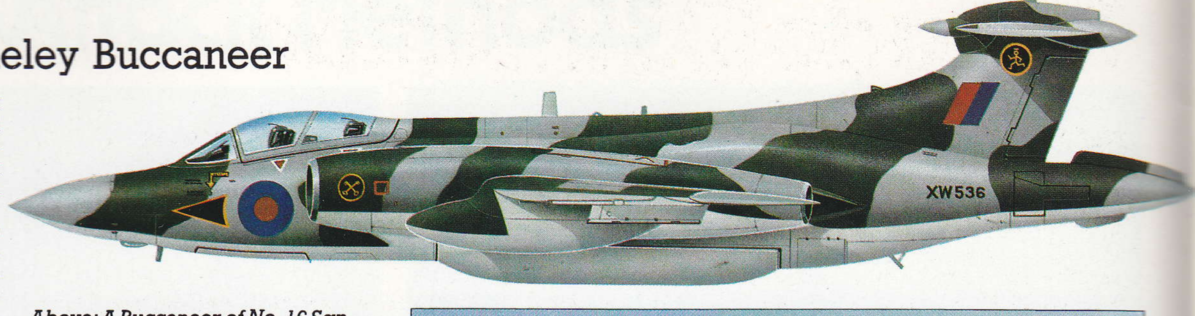
ADD, ORIGINAL, OR NEW> -



ADD, ORIG, UP, DWN, NEW> -

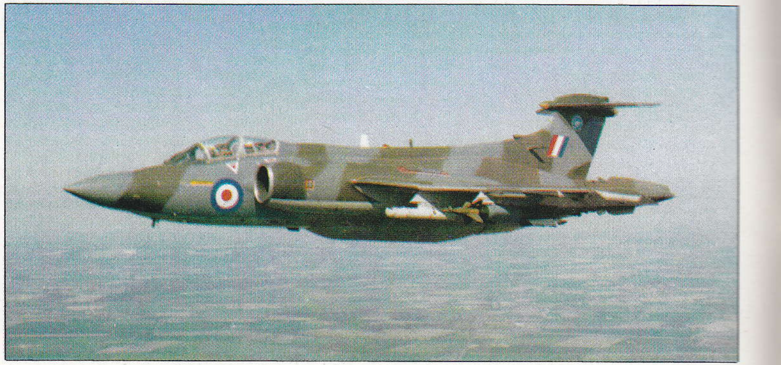
UK

Hawker Siddeley Buccaneer



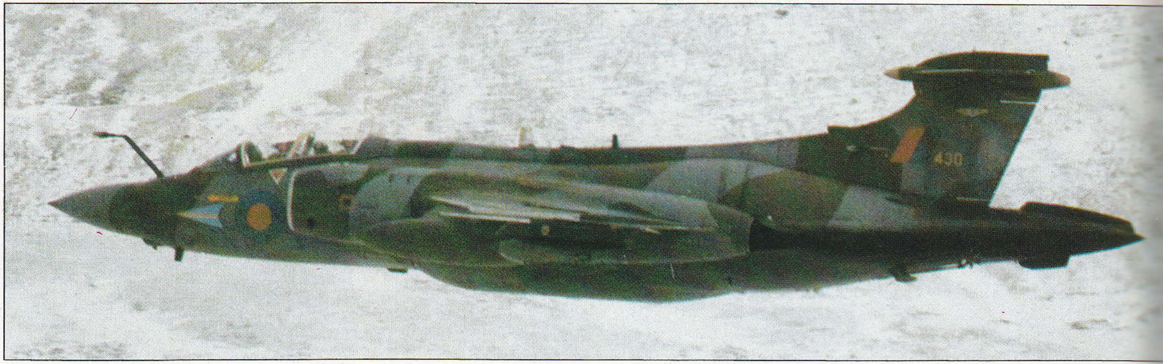
For many years derided (because it was not supersonic) by the RAF and Fleet Street, the **Hawker Siddeley Buccaneer** is one of the best attack aircraft of its era, and it was designed to a far-seeing Admiralty requirement. The latter laid stress on the ability to attack at very low level to evade detection by enemy radars, and the 1953-4 design eventually used extraordinarily advanced boundary-layer control, ejecting engine bleed air through slits ahead of the flaps, ailerons and tailplane. This enabled all aerodynamic surfaces to be made markedly smaller, in turn increasing sea-level speed and greatly reducing buffet. Another good feature was a substantial internal weapon bay, so that with a 4,000-lb (1814-kg) bombload the derided Buccaneer is faster than a Phantom or Mirage with the same load (and, without afterburner, far more fuel efficient). The Gyron Junior-powered **Buccaneer S.Mk 1** (60) was succeeded by the much better **Buccaneer S.Mk 2** with more powerful fan engines, the first production example flying on 5 June 1964. Originally all went to the Fleet Air Arm, apart from 16 **Buccaneer Mk 50** aircraft for the SAAF with boost rocket packs and AS.30 missiles, but survivors were transferred to the RAF (70 out of 84) being designated **Buccaneer S.Mk 2A** with RAF avionics and Martel equipment. A further 43 **Buccaneer S.Mk 2B** aircraft were built to RAF specification, the first flying in January 1970. Immensely capable and popular, the Buccaneer has unique qualities and will serve in maritime attack to the end of the century.

Above: A Buccaneer of No. 16 Sqn, which re-formed on the type at Laarbruch, Germany, in 1972. This squadron has since converted to the Tornado GR.Mk 1.



Right: Today Buccaneers have B-class red/blue national insignia, but this aircraft was engaged on Ministry trials with various external loads.

Below: The Buccaneers of RAF No. 208 Sqn, Honington, will remain operating in the maritime role for the foreseeable future.



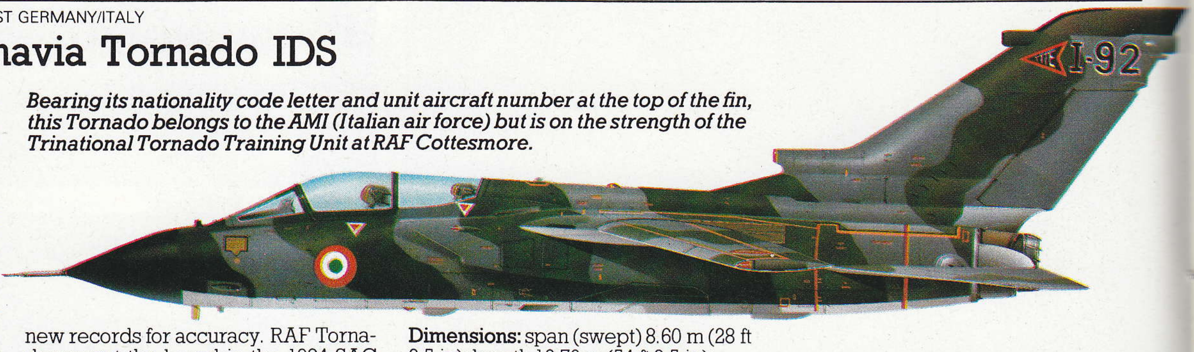
Specification

Hawker Siddeley Buccaneer S.Mk 2B
Type: low-level attack aircraft
Powerplant: two 5103-kg (11,250-lb) thrust Rolls-Royce Spey Mk 101 turbofans
Performance: maximum speed at low altitude with full internal bombload 1110 km/h (690 mph); tactical radius with internal fuel on a hi-lo-hi mission 998 km (620 miles)
Weights: empty 13540 kg (29,850 lb); maximum take-off 28123 kg (62,000 lb)
Dimensions: span 13.41 m (44 ft 0 in); length 19.33 m (63 ft 5 in); height 4.95 m (16 ft 3 in); wing area 47.82 m^2 (514.7 sq ft)
Armament: internal bay for four 454-kg (1,000-lb) bombs, reconnaissance pod or LR tank; four wing pylons each for triple 454-kg (1,000-lb) bombs or various other stores

UK/WEST GERMANY/ITALY

Panavia Tornado IDS

The world's first combat aircraft to be developed by three nations jointly, to meet the requirements of four national customers (RAF, Luftwaffe, Marineflieger and Italian AMI), the **Panavia Tornado** is the world's best long-range low-level interdiction aircraft. No other aircraft combines two small and fuel-efficient engines, a crew of two with an outstandingly modern low-drag tandem cockpit, swing-wings for efficient subsonic loiter but treetop-height dash at 1483 km/h (921 mph) and the ability to carry every tactical store in the European NATO armoury. Despite this, the Tornado is a relatively small aircraft, with a shorter body than the F/A-18 and a wing so much smaller that the gust response in the low high-speed attack role (at speeds 35 per cent higher than the limit for the US aircraft) is more than 10 times better. Including four of the six pre-series aircraft, the customer procurement by 1982 totalled 644: 212 for the Luftwaffe, 112 for the Marineflieger, 220 for the RAF and 100 for the AMI. Production is proceeding steadily, with the Tornado entering squadron service with all three nations in increasing numbers. Weapon-delivery trials by many methods have in numerous cases set new records for accuracy. RAF Tornados swept the board in the 1984 SAC 'Giant Voice' bombing competition!

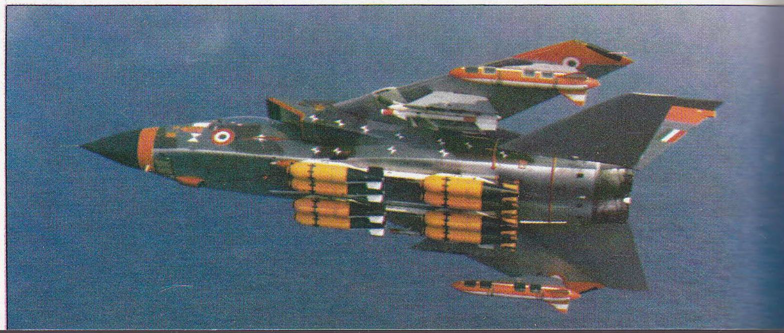


Bearing its nationality code letter and unit aircraft number at the top of the fin, this Tornado belongs to the AMI (Italian air force) but is on the strength of the Trinational Tornado Training Unit at RAF Cottesmore.

Specification

Panavia Tornado IDS (RAF Tornado GR.Mk 1)
Type: All-weather multi-role attack and reconnaissance aircraft
Powerplant: two 7167-kg (15,800-lb) thrust Turbo-Union RB.199 Mk 101 (from 1983, uprated Mk 103) augmented turbofans
Performance: maximum speed, clean at high altitude 2414 km/h (1,500 mph); radius (on a hi-lo-lo-hi mission with 3628 kg/8,000 lb of bombs) 1390 km (863 miles)
Weights: empty about 14000 kg (30,865 lb); maximum over 26490 kg (58,400 lb)
Dimensions: span (swept) 8.60 m (28 ft 2.5 in); length 16.70 m (54 ft 9.5 in); height 5.70 m (18ft 8.5 in); wing area not stated
Armament: two 27-mm Mauser cannon; total of 8165 kg (18,000 lb) of disposable stores on two tandem fuselage pylons plus four swivelling wing pylons, plus centreline for multi-sensor reconnaissance pod

Below: Another Italian AMI Tornado, this time based in Italy, showing a typical conventional attack load of eight BL.755 cluster bombs, two self-defence Sidewinders and two Elettronica ECM pods. Britain, Germany and Italy all use different ECM jammer pods.



Tornado IDS in Action

The most important single type of combat aircraft in Western Europe, the Tornado is at present serving in its initial attack form with the RAF, Luftwaffe, Marineflieger and Aeronautica Militare Italiano. This account is a first-hand impression of what it is like to fly a Tornado for a living, the chosen unit being a wing of the Marineflieger.

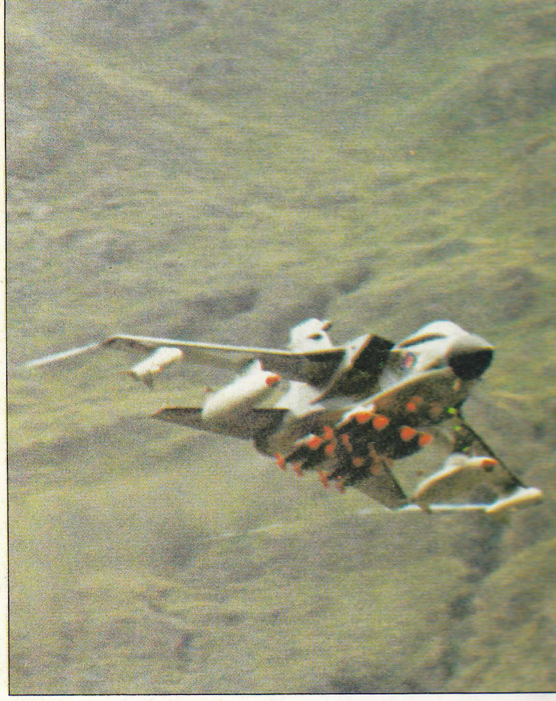
No strident klaxon sounds, nor does a voice from the public-address system pierce the night, as the Schleswig base comes to life at 03.30 in the morning. Rain falls steadily through the darkness as 40 pilots and 40 navigators (called WSOs, weapon-system officers) force sleep from their eyes and adjust to a state of high alertness. Looking inflated in their Day-Glo orange 'poopy suits', they bundle into the operations shelters of Nos 1 and 2 Squadrons of Marinefliegergeschwader 1 and start the day's work.

MFG 1 completed its conversion from the Lockheed F-104G to the Panavia Tornado in 1983. Some pilots found it difficult to share the workload with a backseater, but most found the transition a wonderful experience. Each mission became pure pleasure, especially when real challenges were imposed. Unlike the F-104, the Tornado was designed from the start to carry very heavy loads of bombs or missiles at the lowest possible levels through heavily defended airspace and deliver them with pinpoint accuracy in the worst weather. Every man in MFG 1 knew by mid-1984 that he could do this with unfailing certainty.

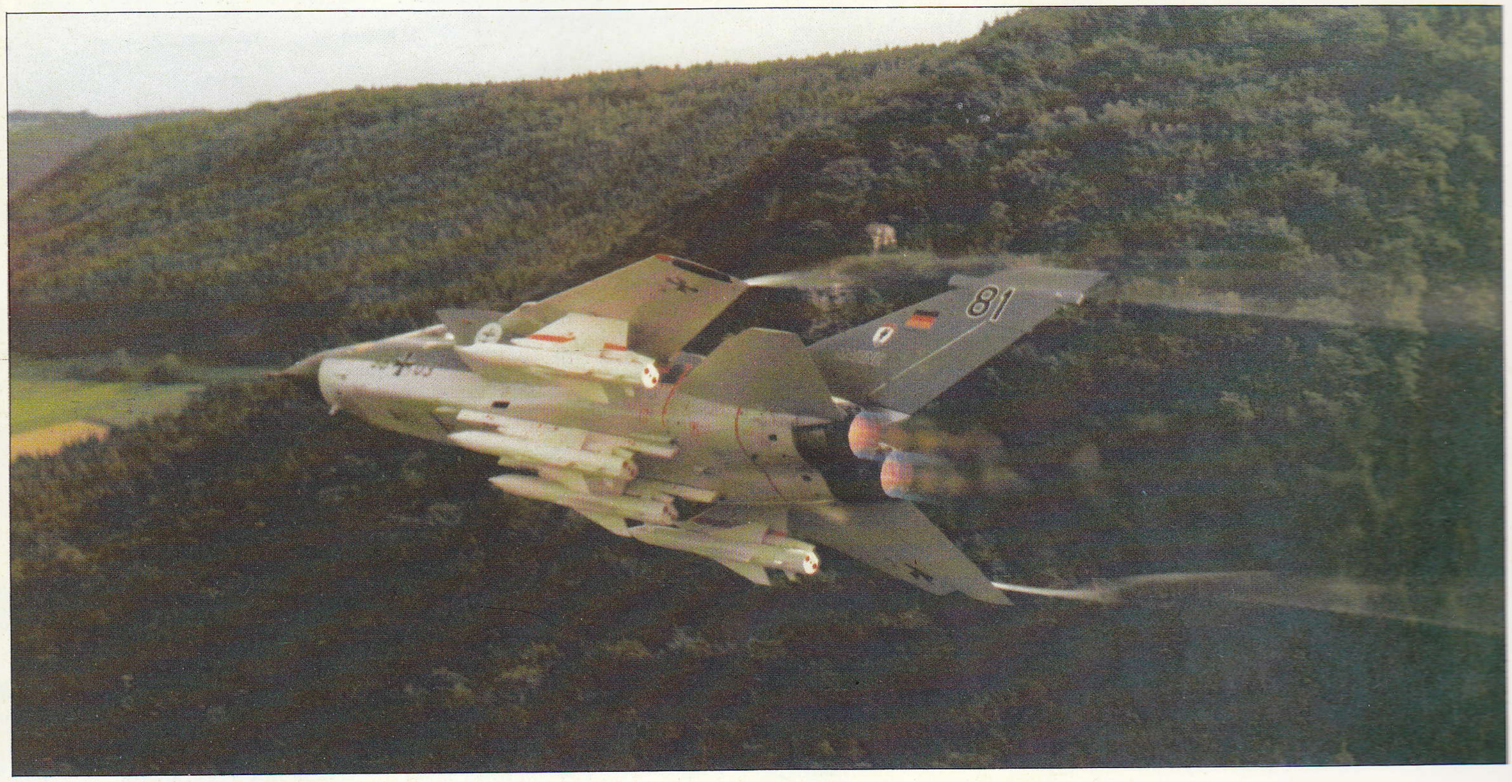
On this wet morning single aircraft are being launched at short intervals to bring back a complete reconnaissance picture of most of the Baltic area. Others are to attack a ship target with missiles. In a few minutes each crew has to absorb a vast amount of information on tasks, code-words, alert states, electronic-warfare policies, control of emissions (by timing, wavelengths and many other variables), as well as factors such as airfields and alternates, weather trends and special security considerations. Much of the information, including complete details of the mission, are prerecorded and loaded into the aircraft's computer memories before take-off.

During the night Schleswig's armoury has been dispensing many kinds of ordnance: 27-mm ammunition made up into different formations in giant belts; free-fall, guided and retarded bombs; rockets; practice bombs; and, biggest of all, the Kormoran missiles, each of which can knock out and even sink almost any ship. The firepower of each aircraft is now so great that many tasks can be assigned to a single aircraft; few assignments need more than two or three. As far as possible MFG 1, like all the 40-odd combat-ready Tornado units in Europe, aims to complete its mission undetected, except perhaps at the target where the Tornado's presence is very obvious indeed. Comprehensive ECM jamming and dispenser systems are used in conjunction with the maximum radio and radar silence as the lone penetrator streaks to its target, hugging the Earth's surface.

After half an hour of preparation the crews have all completed their computer tapes and worked out their exact procedures with clinical precision. How different from World War II! For a mission to be 'scrubbed' because of bad weather is almost unthinkable, and it is equally exceptional for an aircraft to abort with unserviceability, despite the fantastic on-board complexity. We gather up our mass of gear (film cassettes, maps, charts and booklets in a bag, plus lifejackets and helmets) and walk out to the waiting line-taxi which speeds us almost silently to Shelter 17. Here in dimmed lighting we arrive just as the vast steel doors complete their slow opening procedure. We sign for our aircraft and do a careful walkaround, noting two body Kormorans, two full tanks, two self-defence Sidewinders, one Zeus active jammer pod and one BOZ.100 chaff/flare dispenser pod. It is nothing like a maximum load, but still approximately double the limit for an F-104.



At low level the Tornado is probably the fastest aircraft in the world, cleared to 800 kts (921 mph/ 1480 km/h). This GR.Mk 1 of the RAF is on exercise down a Welsh valley with eight 454-kg (1,000-lb) retarded bombs, two tanks and two Marconi Sky Shadow ECM jammer pods.



At well over 1000 km/h (621 mph) in full afterburner, this Tornado of MFG 1 is armed with four Kormoran anti-ship missiles, but is not carrying tanks or ECM pods (the German jammer pod is the Zeus).

It is not often one sees a display of weapons at an operational station (in this case RAF Honington), and even more rarely is the display as varied as this; Tornado has been cleared with more types of store than any aircraft except the F-4. The unit is No. 9 Sqn.

We climb aboard, and in seconds check out the cockpit. Tightly strapped into the Martin-Baker Mk 10 seat, we check stowage of the pins and then follow with the similar pins for the EPS (emergency power supply), canopy and MDC (micro-detonating cord).

Now let battle commence. Reaching out with our left arm we push the APU (auxiliary power unit) start button. No external power of any kind is needed; we could get going just as well at the North Pole. The tiny gas turbine whines almost inaudibly far at the rear, but in seconds we have full onboard power and can then fire up the main engines. The APU drives by shaft-power, via the right-hand gearbox, and can be coupled to crank up either RB.199 engine in sequence. In 30 seconds we are ready to move, canopy shut, inertial system run up and aligned and all systems GO. The shelter launch light shows green, so whilst checking control movements and the HUD (head-up display) for the correct mode, we sweep the wings part way back, pulling back the distinctive lever on the left front console, and roll quickly into the darkness, stabbing the brakes to hold speed down, and restoring the wings to 25°.

Automatic flight

Take-off checks are complete long before we reach the long runway; without stopping we go straight into maximum reheat and the Tornado surges forward like a dragster. In seconds we select gear up, flaps up, cancel reheat and turn hard to the right on course. There is almost nothing to do as we thunder across the invisible flat countryside at 60 m (200 ft), cross the coast and enter the Kattegat between the great islands of Denmark. The autopilot does it all, the autothrottles holding our speed and the radar altimeter and TFR (terrain-following radar) maintaining the exact clearance above the water. Should a big ship loom ahead, we would see it in the HUD and on the E-scope radar display, and the TFR would pull us either up or around it. The inertial system and many other sources of information keep precise tabs on where we are, and at what time; we must not be a second early or late. In daylight we might choose to fly manually, but at night this is impossible, just as it is in dense fog or snow. Then we need to have complete confidence in those little electrons flying through those microscopic circuits, which are keeping us alive throughout the mission.

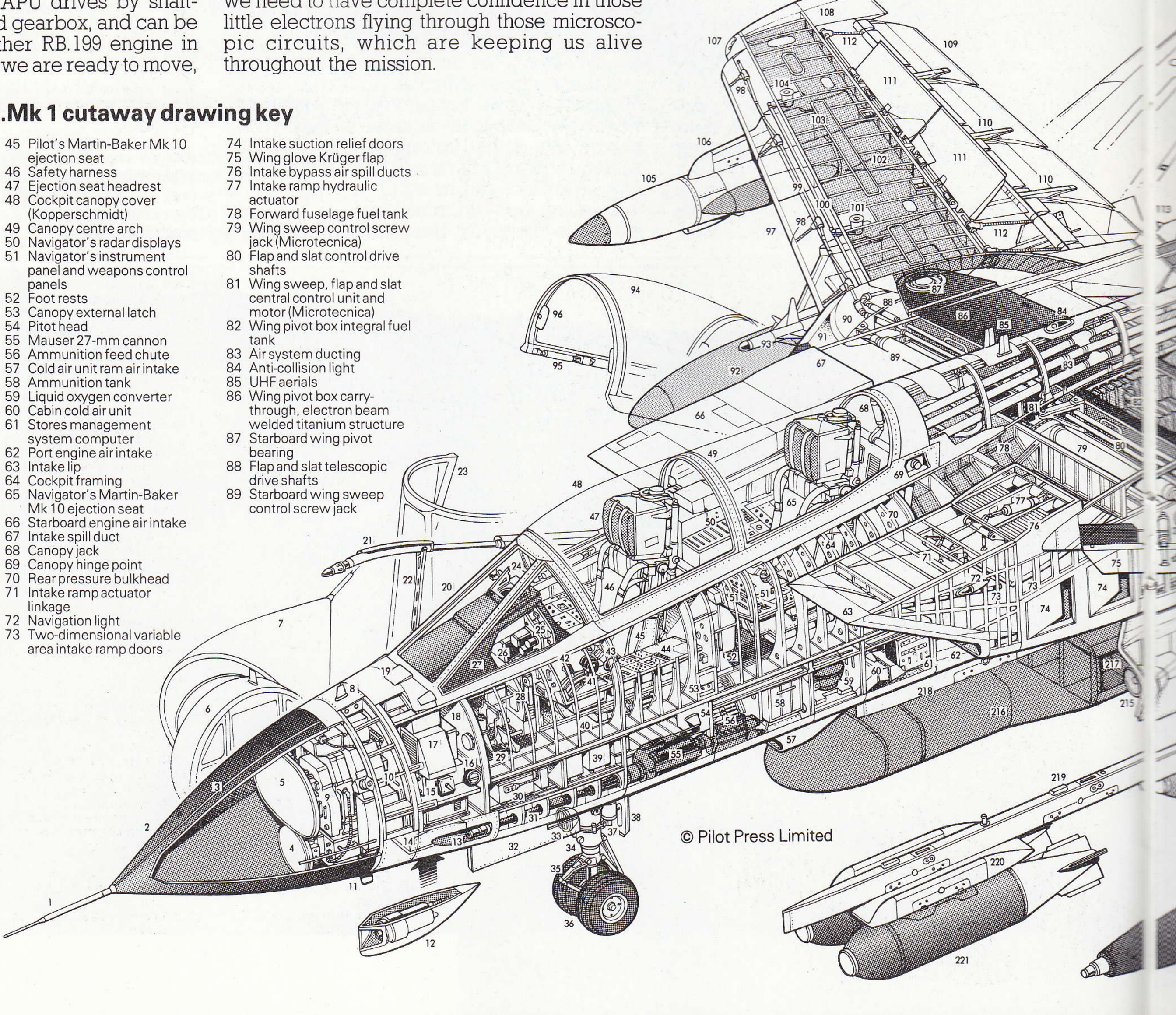
Somewhere ahead, towards Oslo and about 50 km (31 miles) off the Swedish coast to the right, is our target. As we head towards it at a steady 925 km/h (575 mph) we suddenly get an update of its exact position from another MFG 1 aircraft. We are not using an initial point and have to be spot-on with the target position. The refined figures are quickly inserted into the computer and at the right moment we go into reheat for the attack. In seconds it comes into view on the radar and we 'launch' one of our Kormorans, at the next moment banking vertically away on to an exit heading. WEAPON AWAY continues to glow on the weapon control panel dead ahead under the big projected map display, though really the costly Kormoran is still securely attached and everything has been done by electronic means (and is at this moment on tape, for subsequent playback).

Fighters approaching

We get a warning of fighters from an MFG 1 aircraft a few kilometres away. We go into the manual mode, in full reheat, and rise a little further above the sea. Dawn is near and the horizon is visible, and now we can make life hard for anyone who tries to intercept us. With its computerized flight-controls and stability augmentation system the Tornado can manoeuvre as well as all but one or two of the very newest fighters, and we can show a clean pair

Panavia Tornado GR.Mk 1 cutaway drawing key

1 Air data probe
2 Radome
3 Lightning conductor strip
4 Terrain following radar antenna
5 Ground mapping radar antenna
6 Radar equipment bay hinged position
7 Radome hinged position
8 IFF aerial
9 Radar antenna tracking mechanism
10 Radar equipment bay
11 UHF/TACAN aerial
12 Laser Ranger and Marked Target Seeker (Ferranti), starboard side
13 Cannon muzzle
14 Ventral Doppler aerial
15 Angle of attack transmitter
16 Canopy emergency release
17 Avionics equipment bay
18 Front pressure bulkhead
19 Windscreen rain dispersal air ducts
20 Windscreen (Lucas-Rotax)
21 Retractable, telescopic, inflight refuelling probe
22 Probe retraction link
23 Windscreen open position, instrument access
24 Head-up display, HUD (Smiths)
25 Instrument panel
26 Radar 'head-down' display
27 Instrument panel shroud
28 Control column
29 Rudder pedals
30 Battery
31 Cannon barrel
32 Nosewheel doors
33 Landing/taxiing lamp
34 Nose undercarriage leg strut (Dowty-Rotol)
35 Torque scissor links
36 Twin forward-retracting nosewheels (Dunlop)
37 Nosewheel steering unit
38 Nosewheel leg door
39 Electrical equipment bay
40 Ejection seat rocket pack
41 Engine throttle levers
42 Wing sweep control lever
43 Radar hand controller
44 Side console panel
45 Pilot's Martin-Baker Mk 10 ejection seat
46 Safety harness
47 Ejection seat headrest
48 Cockpit canopy cover (Kopperschmidt)
49 Canopy centre arch
50 Navigator's radar displays
51 Navigator's instrument panel and weapons control panels
52 Foot rests
53 Canopy external latch
54 Pitot head
55 Mauser 27-mm cannon
56 Ammunition feed chute
57 Cold air unit ram air intake
58 Ammunition tank
59 Liquid oxygen converter
60 Cabin cold air unit
61 Stores management system computer
62 Port engine air intake
63 Intake lip
64 Cockpit framing
65 Navigator's Martin-Baker Mk 10 ejection seat
66 Starboard engine air intake
67 Intake spill duct
68 Canopy jack
69 Canopy hinge point
70 Rear pressure bulkhead
71 Intake ramp actuator linkage
72 Navigation light
73 Two-dimensional variable area intake ramp doors
74 Intake suction relief doors
75 Wing glove Krüger flap
76 Intake bypass air spill ducts
77 Intake ramp hydraulic actuator
78 Forward fuselage fuel tank
79 Wing sweep control screw jack (Microtecnica)
80 Flap and slat control drive shafts
81 Wing sweep, flap and slat central control unit and motor (Microtecnica)
82 Wing pivot box integral fuel tank
83 Air system ducting
84 Anti-collision light
85 UHF aerials
86 Wing pivot box carry-through, electron beam welded titanium structure
87 Starboard wing pivot bearing
88 Flap and slat telescopic drive shafts
89 Starboard wing sweep control screw jack



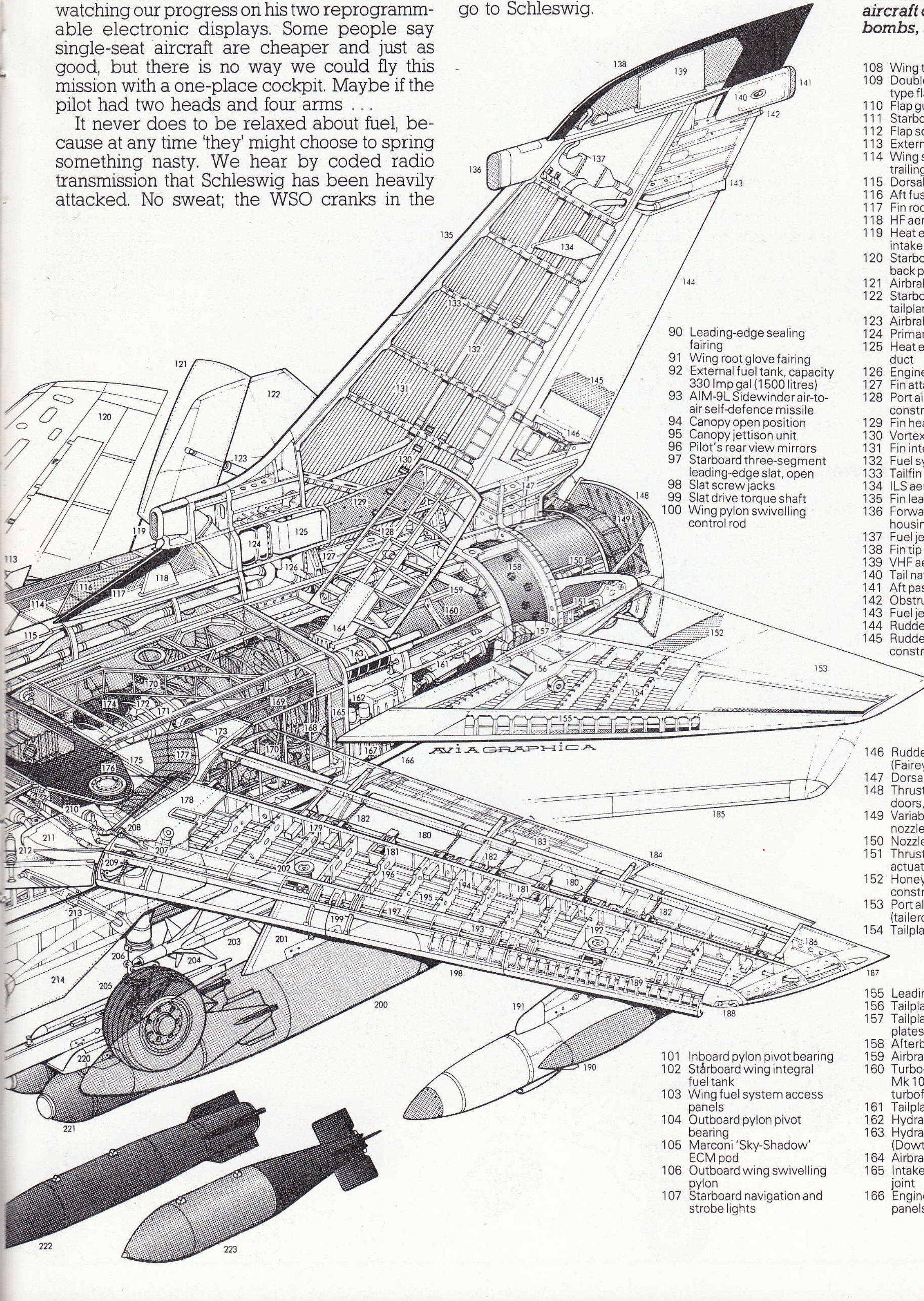
© Pilot Press Limited

of heels to most. We put the main radar and HUD into an air-combat snapshoot mode and suddenly are able to frighten a 'hostile' by launching a Sidewinder (again purely electronically, but with the missile's IR-homing head properly locked-on) at a fighter that we had been watching for several seconds as it tried to attack another Tornado. Despite the violent manoeuvring in reheat the RB.199s are so small and economical that we are still using our external fuel, and if we had to we could go for a quick trip right round the British Isles (but not at sea level).

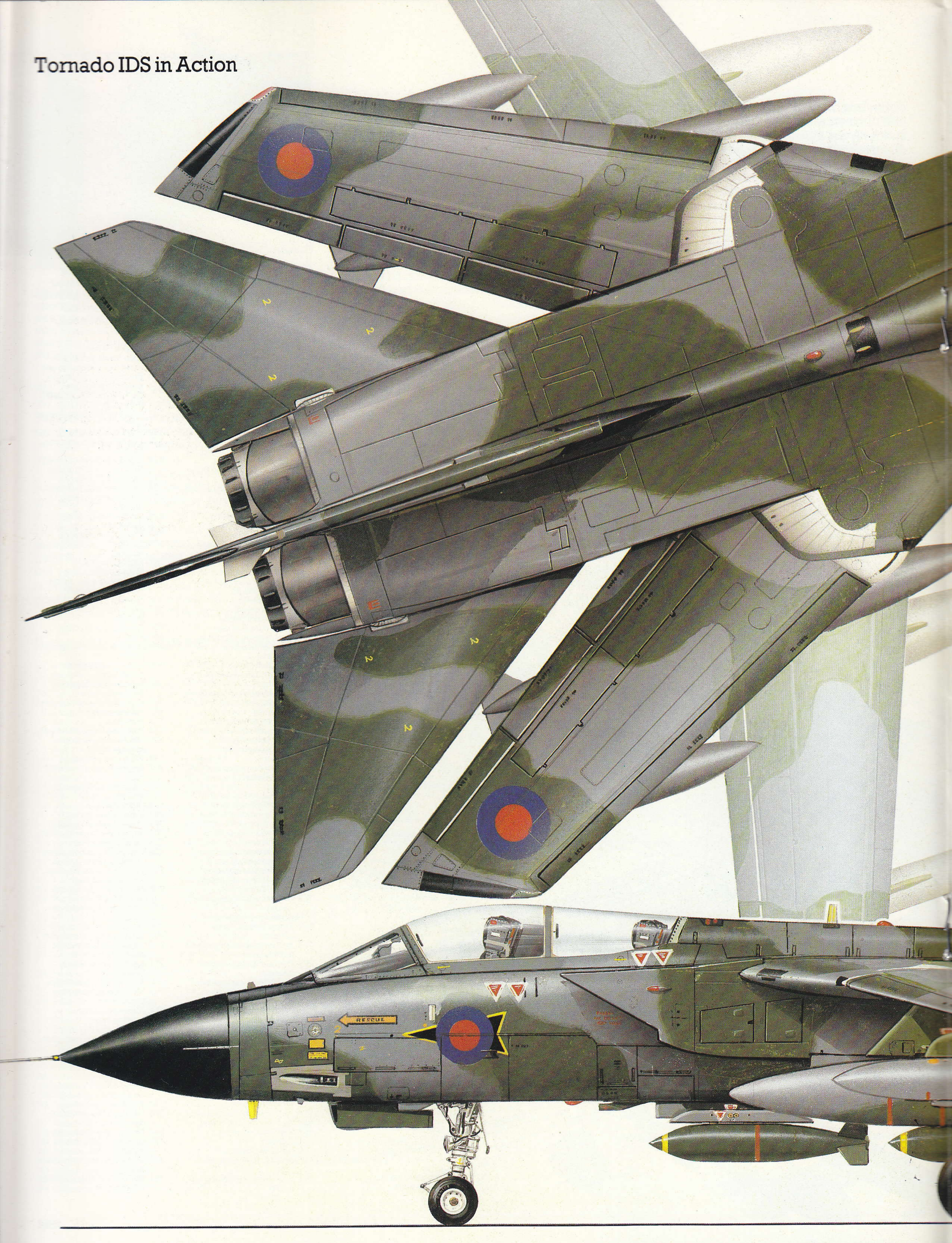
All the time the WSO in the back has been watching our progress on his two reprogrammable electronic displays. Some people say single-seat aircraft are cheaper and just as good, but there is no way we could fly this mission with a one-place cockpit. Maybe if the pilot had two heads and four arms ...

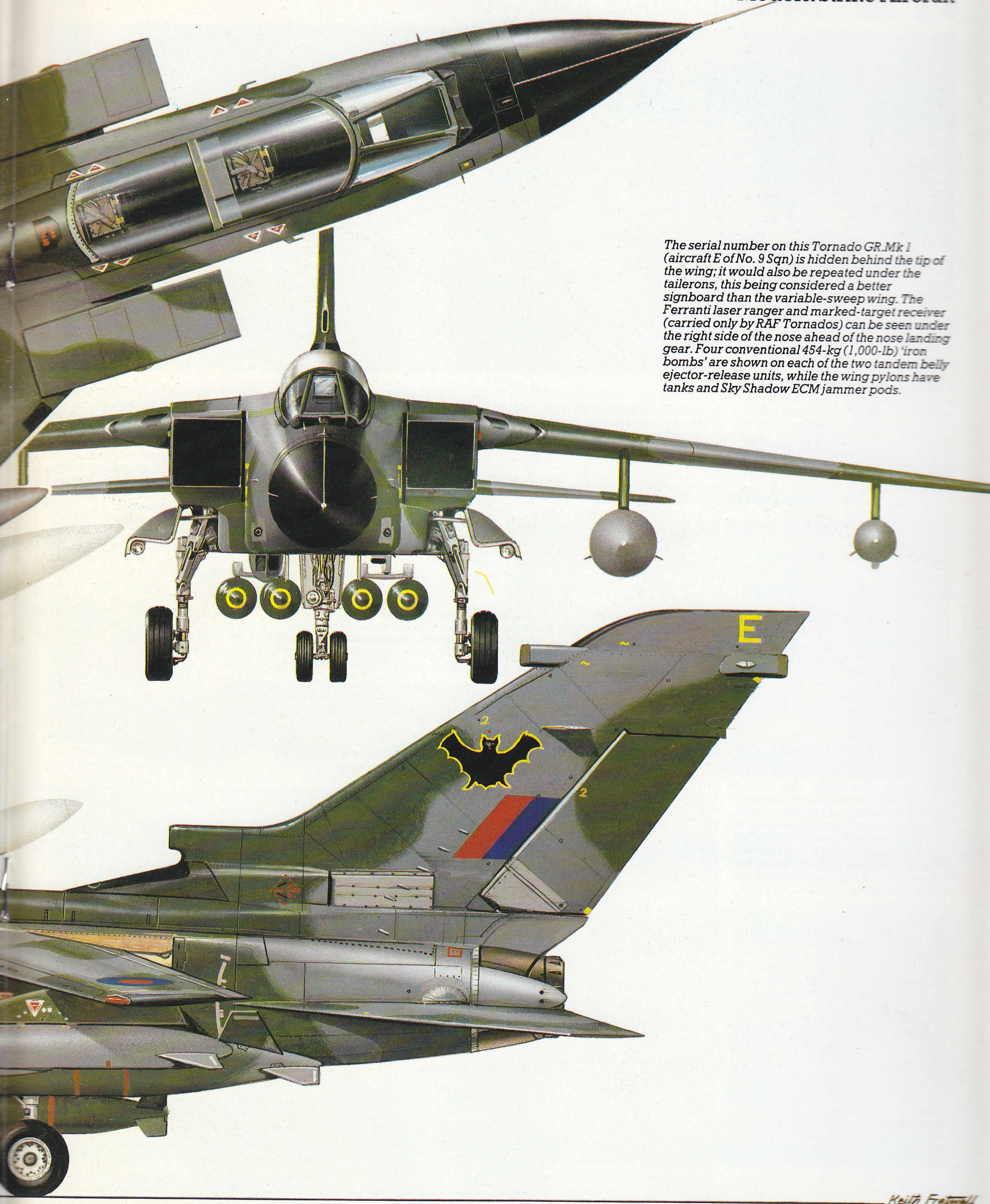
It never does to be relaxed about fuel, because at any time 'they' might choose to spring something nasty. We hear by coded radio transmission that Schleswig has been heavily attacked. No sweat; the WSO cranks in the co-ordinates of an alternate, Eggebeck, on the Danish frontier. The computer never complains but effortlessly banks us on the correct heading and even adjusts the throttles as we enter the circuit. We take over manually for the landing, making a radar approach despite the growing daytime visibility. Soft touchdown, slam the reversers in and slow to walking pace in little over 300 m (1,000 ft). Turn off with the beautifully precise nosewheel steering at the first intersection (impossible for an F-104 to make the third one!), shut down the right engine to slow the taxi roll and then park where we are told. Minutes hence we'll be allowed to go to Schleswig.

Two Tornado GR.Mk 1s of RAF No. 9 Sqn, from Honington, reach a turning point on a simulated mission exercise. The underfuselage load on both aircraft comprises 454-kg (1,000-lb) retarded bombs, the wings having tanks and ECM pods.



90 Leading-edge sealing fairing
91 Wing root glove fairing
92 External fuel tank, capacity 330 Imp gal (1500 litres)
93 AIM-9L Sidewinder air-to-air self-defence missile
94 Canopy open position
95 Canopy jettison unit
96 Pilot's rear view mirrors
97 Starboard three-segment leading-edge slat, open
98 Slat screw jacks
99 Slat drive torque shaft
100 Wing pylon swivelling control rod
101 Inboard pylon pivot bearing
102 Starboard wing integral fuel tank
103 Wing fuel system access panels
104 Outboard pylon pivot bearing
105 Marconi 'Sky-Shadow' ECM pod
106 Outboard wing swivelling pylon
107 Starboard navigation and strobe lights
108 Wing tip fairing
109 Double-slotted Fowler-type flaps, down position
110 Flap guide rails
111 Starboard spoilers, open
112 Flap screw jacks
113 External fuel tank tail fins
114 Wing swept position trailing edge housing
115 Dorsal spine fairing
116 Aft fuselage fuel tank
117 Fin root antenna fairing
118 HF aerial
119 Heat exchanger ram air intake
120 Starboard wing fully swept back position
121 Airbrake, open
122 Starboard all-moving tailplane (taileron)
123 Airbrake hydraulic jack
124 Primary heat exchanger
125 Heat exchanger exhaust duct
126 Engine bleed air ducting
127 Fin attachment joint
128 Port airbrake rib construction
129 Fin heat shield
130 Vortex generators
131 Fin integral fuel tank
132 Fuel system vent piping
133 Tailfin structure
134 ILS aerial
135 Fin leading edge
136 Forward passive ECM housing
137 Fuel jettison and vent valve
138 Fin tip antenna fairing
139 VHF aerial
140 Tail navigation light
141 Aft passive ECM housing
142 Obstruction light
143 Fuel jettison
144 Rudder
145 Rudder honeycomb construction
146 Rudder hydraulic actuator (Fairey Hydraulics)
147 Dorsal spine tail fairing
148 Thrust reverser bucket doors, open
149 Variable area afterburner nozzle
150 Nozzle control jacks (four)
151 Thrust reverser door actuator
152 Honeycomb trailing edge construction
153 Port all-moving tailplane (taileron)
154 Tailplane rib construction
155 Leading-edge nose ribs
156 Tailplane pivot bearing
157 Tailplane bearing sealing plates
158 Afterburner duct
159 Airbrake hydraulic jack
160 Turbo-Union R.B.199-34R Mk 101 afterburning turbofan engine
161 Tailplane hydraulic actuator
162 Hydraulic system filters
163 Hydraulic reservoir (Dowty)
164 Airbrake hinge point
165 Intake frame/production joint
166 Engine bay ventral access panels
167 Engine oil tank
168 Rear fuselage fuel tank
169 Wing root pneumatic seal
170 Engine driven accessory gearboxes, port and starboard (KHD), airframe mounted
171 Integrated drive generator (two)
172 Hydraulic pump (two)
173 Gearbox interconnecting shaft
174 Starboard side Auxiliary Power Unit, APU (KHD)
175 Telescopic fuel pipes
176 Port wing pivot bearing
177 Flexible wing sealing plates
178 Wing skin panelling
179 Rear spar
180 Port spoiler housings
181 Spoiler hydraulic actuators actuators
182 Flap screw jacks
183 Flap rib construction
184 Port Fowler-type double-slotted flaps, down position
185 Port wing fully swept back position
186 Wing tip construction
187 Fuel vent
188 Port navigation and strobe lights
189 Leading-edge slat rib construction
190 Marconi 'Sky-Shadow' ECM pod
191 Outboard swivelling pylon
192 Pylon pivot bearing
193 Front spar
194 Port wing integral fuel tank
195 Machined wing skin/stringer panel
196 Wing rib construction
197 Swivelling pylon control rod
198 Port leading-edge slat segments. open
199 Slat guide rails
200 External fuel tank
201 Inboard swivelling pylon
202 Inboard pylon pivot bearing
203 Missile launch rail
204 AIM-9L Sidewinder air-to-air self-defence missile
205 Port mainwheel (Dunlop), forward retracting
206 Main undercarriage leg strut (Dowty-Rotol)
207 Undercarriage leg pivot bearing
208 Hydraulic retraction jack
209 Leg swivelling control link
210 Telescopic flap and slat drive torque shafts
211 Leading-edge sealing fairing
212 Krüger flap hydraulic jack
213 Main undercarriage leg breaker strut
214 Mainwheel door
215 Landing lamp
216 Hunting JP 233 Airfield Attack Weapon (two, side-by-side)
217 Submunitions compartments (30 SG357 runway penetration bombs and 215 HB876 area denial weapons in each JP 233)
218 Port shoulder pylon
219 Fuselage shoulder pylon (two)
220 ML twin stores carriers
221 Hunting BL 755 cluster bombs (eight)
222 Mk 83 high speed retarded bomb
223 Mk 13/15 454-kg (1,000-lb) HE bomb


2
2
2
2
2
2
RESCUE



The serial number on this Tornado GR.Mk 1 (aircraft E of No. 9 Sqn) is hidden behind the tip of the wing; it would also be repeated under the tailerons, this being considered a better signboard than the variable-sweep wing. The Ferranti laser ranger and marked-target receiver (carried only by RAF Tornados) can be seen under the right side of the nose ahead of the nose landing gear. Four conventional 454-kg (1,000-lb) 'iron bombs' are shown on each of the two tandem belly ejector-release units, while the wing pylons have tanks and Sky Shadow ECM jammer pods.

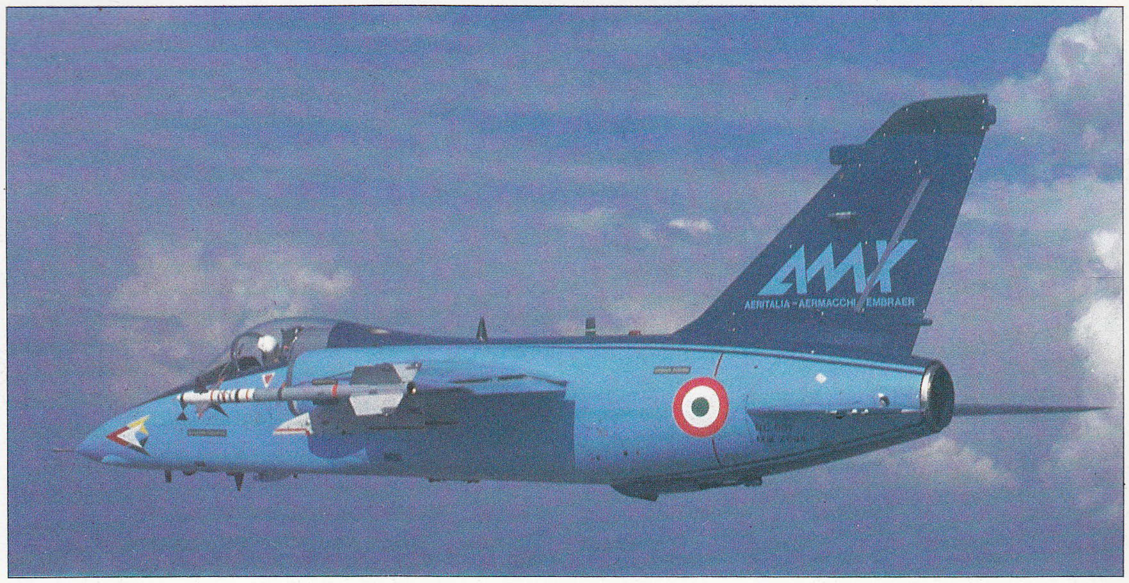
Keith Fretwell

ITALY/BRAZIL

Aeritalia/EMBRAER AMX

This extremely attractive light attack aircraft was launched to meet a need of the Aeronautica Militare Italiana to replace the Fiat G91 and Lockheed F-104G. The Brazilian air staff decided they had a need for a similar aircraft, mainly to replace the EMBRAER AT-26 Xavante (itself a licensed Italian design, the Aermacchi M.B. 326GB). The eventual airframe team comprises Aeritalia in partnership with Aermacchi in Italy and EMBRAER in Brazil, the latter having a 30 per cent share by value made up of the complete wing, air inlets, tailplane and pylons. Aeritalia has 46 per cent, comprising the centre fuselage, wing movables, vertical tail, elevators and radome. Aermacchi has 24 per cent, comprising the nose fuselage (with cockpit and avionics integration), tailcone and canopy.

The emphasis of the **AMX** has wisely been on simplicity and affordability. Useful short-field ability has been achieved by a good thrust/weight ratio and excellent high-lift devices. The AMI has an initial requirement for 187 AMX aircraft, while the Brazilian FAB expects to receive 79, with different avionics and guns, as outlined below. All versions have a fuselage bay in which can be accommodated three different kinds of reconnaissance pallet or other mission avionics, though an IR/EO (infra-red/electro-optics) pod is normally hung externally on the centreline. The first AMX crashed, but the second prototype flew soon afterwards and in late 1984 development was on schedule.



The first prototype AMX was tragically lost early in its test programme, test pilot Quarantelli succumbing to the injuries he sustained. The second aircraft took over flight development at once, after its roll-out on 5 July 1984.

Specification

Aeritalia/Aermacchi/EMBRAER AMX

Type: single-seat tactical attack and reconnaissance aircraft

Powerplant: one 5000-kg (11,032-lb) thrust Italian-built Rolls-Royce Spey 807 turbofan

Performance: maximum speed not disclosed but about 1130 km/h (700 mph) clean at sea level; attack radius with full allowances (2722-kg/6,000-lb bombs on a hi-lo-hi mission) 520 km (321 miles)

Weights: empty 6000 kg (13,228 lb); maximum take-off 11500 kg (25,353 lb)

Dimensions: span (over AAMs) 10.00 m (32 ft 9.7 in); length 13.575 m (44 ft 6.5 in); height 4.576 m (15 ft 0.2 in); wing area 21.0 m^2 (226 sq ft)

Armament: (Italian) one 20-mm M61A1 multi-barrel cannon with 350 rounds, (Brazilian) two 30-mm DEFA 553 cannon each with 130 rounds, plus a total of 3500 kg (7,716 lb) of ordnance hung on five external pylons, not including two Sidewinder self-defence air-combat AAMs on wingtip rails

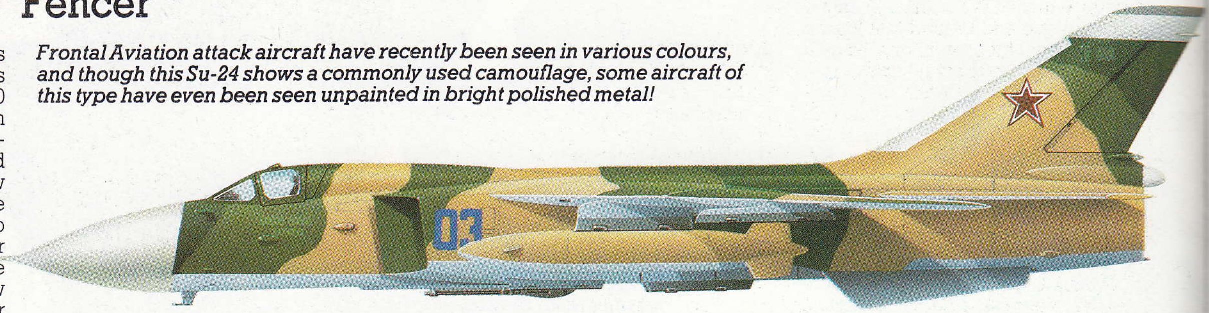
---

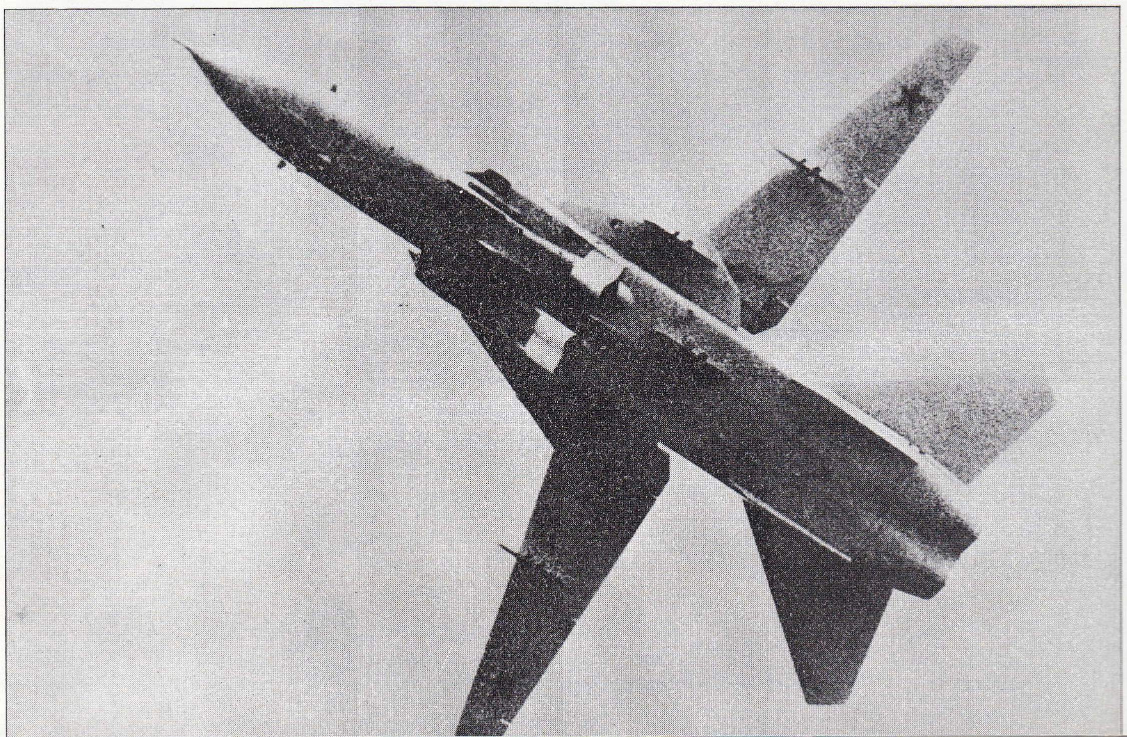
USSR

Sukhoi Su-24 'Fencer'

Just as TsAGI produced the shapes adopted by all the major constructors of supersonic aircraft of the 1955-80 era, so did it develop both an interim swing-wing scheme for modifying existing aircraft (applied to the Su-7 and Tu-22) and also an ideal shape for new designs. The latter was adopted by the MiG bureau for the MiG-23/27 and also by Sukhoi for its **Sukhoi Su-24**, the latter having exactly twice the power of the MiG aircraft. Unlike the MiG the new Sukhoi has been developed purely for long-range all-weather attack, and there is no known fighter version (though parts may be used in the Su-27 'Ram-K'). In many respects the Su-24 is similar to the American F-111, though it is smaller, lighter, much more powerful and has a belly that can be festooned with weapons. Features include a large forward-looking radar, side-by-side seats, twin guns with bulged ventral fairings partly formed by the twin airbrakes, variable lateral inlets and twin ventral fins on the flanks of the wide fuselage. A very heavy load of at least 25 different types of external store can be carried, and missions can be flown to the tip of Brittany, Scotland or as far as Spain. Called **'Fencer'** by NATO, this efficient and well-equipped aircraft has given the Soviet FA (Frontal Aviation) a quantita-

Frontal Aviation attack aircraft have recently been seen in various colours, and though this Su-24 shows a commonly used camouflage, some aircraft of this type have even been seen unpainted in bright polished metal!

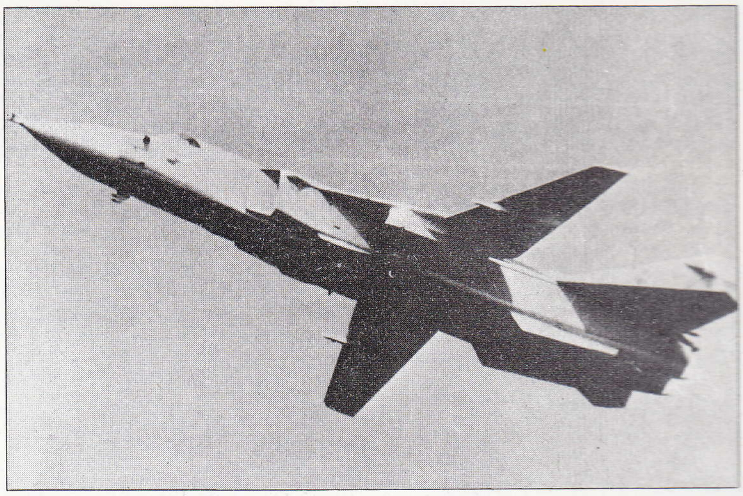




Looking up at an Su-24 with the wings at minimum sweep. In the landing pattern, this aircraft has the twin speed brakes part-open. NATO codenames have been applied to three positively identified variants of this formidable aircraft, but details are unknown.

tive edge over the West and also a large qualitative one. The Tornado is a Western counterpart, but it is smaller and later in timing, and is being produced at a slower rate.

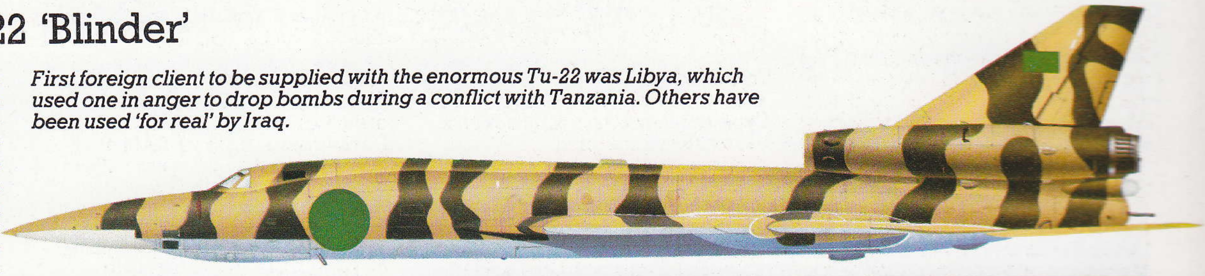
Specification
Sukhoi Su-24
Type: all-weather attack aircraft
Powerplant: believed to be two 12700-kg (27,998-lb) Tumansky R-29B augmented turbofans
Performance: (estimated) maximum speed, clean at high altitude over 2124 km/h (1,320 mph) or Mach 2; radius on a hi-lo-hi mission with 4000-kg (8,818-lb) bombload 1400 km (870 miles)
Weights: (estimated) empty 19050 kg (41,998 lb); maximum take-off 39500 kg (87,083 lb)
Dimensions: (estimated) span (16°) 17.15 m (56 ft 3 in); length 21.29 m (69 ft 10 in); height 5.5 m (18 ft 0 in); wing area not published
Armament: eight external pylons each rated at 1000 kg (2,205 lb) for bombs (including tactical nuclear), various air-to-surface missiles (including AS-7 'Kerry', AS-9, AS-10 and AS-11), rocket pods, cluster dispensers and other stores; two guns of 23-mm or larger calibre under fuselage



Another 'Fencer' in the circuit at an airfield of the GSFG (Group of Soviet Forces in Germany). In this case the twin airbrakes – which cover a gun and (it is believed) a weapon-aiming sensor – are closed. Some of the eight pylons, which give the aircraft an 8000-kg (17,637-lb) ordnance capacity are visible.

USSR

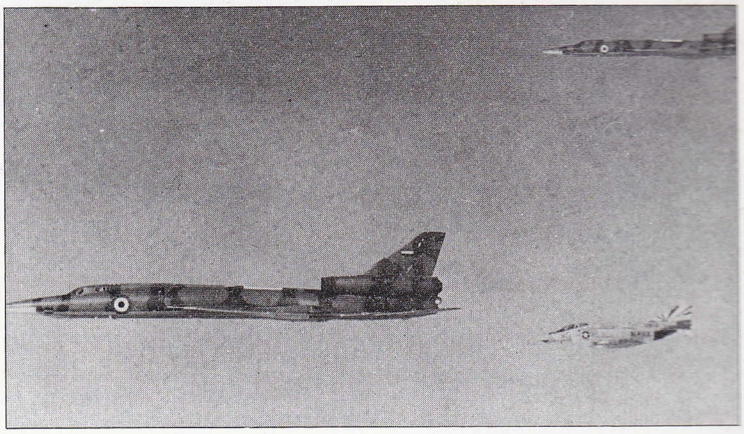
Tupolev Tu-22 'Blinder'



First foreign client to be supplied with the enormous Tu-22 was Libya, which used one in anger to drop bombs during a conflict with Tanzania. Others have been used 'for real' by Iraq.

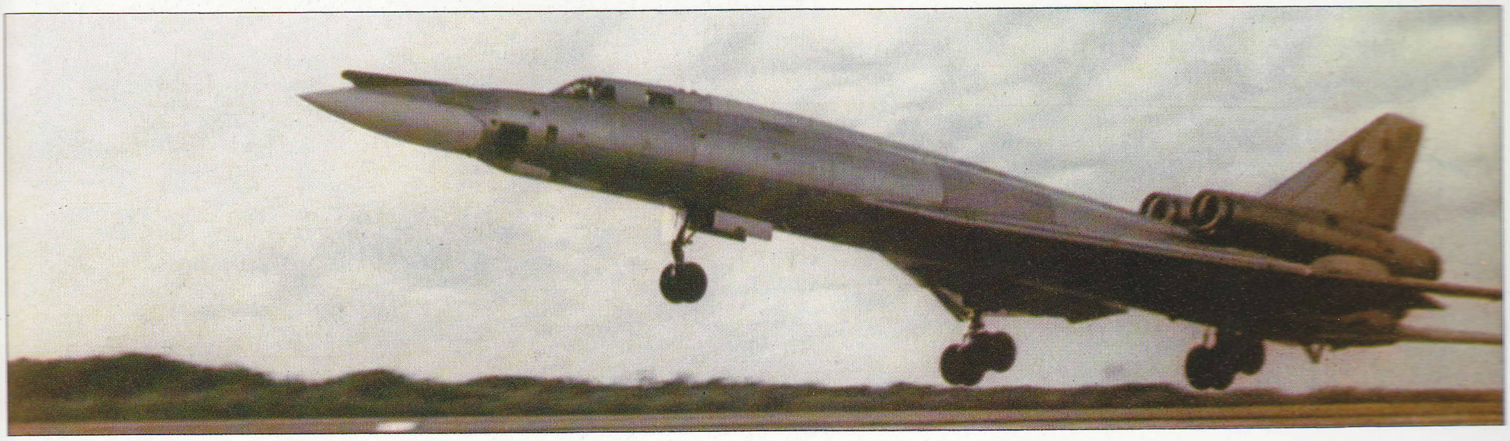
Displayed publicly in 1961, the **Tupolev Tu-22** was larger and more powerful than previous Soviet supersonic bombers, and though it still lacked the range for many missions, it was put into production and about 250 were built in four versions, all equipped with an inflight-refuelling probe. The basic free-fall bomber, named **'Blinder-A'** by NATO, was deployed in limited numbers from 1965, but the main production centred on the **'Blinder-B'** missile-carrier and various **'Blinder-C'** reconnaissance and electronic-warfare platforms, as well as a few **'Blinder-D'** dual trainers with the instructor in a second cockpit above and behind that for the original pilot. Most versions have a large mapping and navigation radar in the pointed nose, followed by a navigator/bombardier compartment with glazed downlook windows. Aft of the pressurized cockpit section is an enormous fuselage tank, behind which is the unique engine installation on each side of the fin, with the nozzles close to the rear warning radar, ECM aerials and remote-control tail cannon. In 1983 about 125 of the 'Blinder-A' and 'Blinder-B' versions remained operational, as well as a squadron in Libya and a few in Iraq. The most active version is 'Blinder-C', of which about 40 continue to fly intensively with the AV-MF (Soviet naval air force) on maritime reconnaissance and electronic-warfare duties with various fits of cameras, IR linescan, passive receivers and, in some aircraft, ECM jammers and dispensers. The free-fall bomber version has been used in action over Iran, Iraq (against Kurds), Tanzania (by Libya) and most recently against Afghan rebels by the Soviet air force.

Specification
Tupolev Tu-22 'Blinder-A/B'
Type: bomber and missile-carrier
Powerplant: believed to be two 14000-kg (30,864-lb) thrust Kolesov VD-7 afterburning turbojets
Performance: maximum speed at high altitude about 1480 km/h (920 mph) or Mach 1.4; radius on a hi-lo-hi mission with maximum bombload 3100 km (1,926 miles)
Weights: empty about 40800 kg (89,949 lb); maximum take-off 84000 kg (185,188 lb)
Dimensions: span 27.7 m (90 ft 10.5 in); length 40.53 m (132 ft 11.5 in); height 10.67 m (35 ft 0 in); wing area 145.0 m^2 (1,560.8 sq ft)
Armament: (A) up to 10000 kg (22,046 lb) of bombs or (B) one AS-4 'Kitchen' missile; two 23-mm tail cannon in remote-control barbette



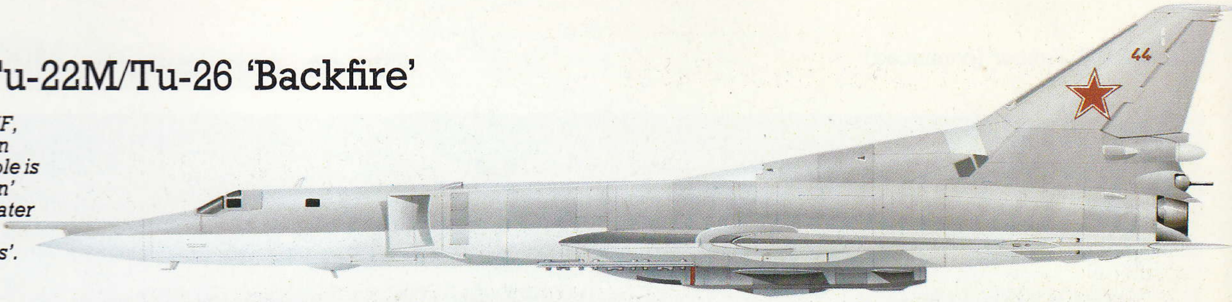
Above: Taken when Tu-22s were being delivered to Libya in April 1977, this photograph shows the original national insignia used by that country. The escorting US Navy F-4N came from VF-111 'The Sundowners'. Inflight refuelling is not fitted to Libyan Tu-22 bombers.

Below: Take-off by one of the first production Tu-22s, showing the socket above the nose for the inflight-refuelling probe (which is not fitted). The fuselage, vertical tail and inner wing survive basically unchanged in today's 'Backfire'.



USSR

Tupolev Tu-22M/Tu-26 'Backfire'



A 'Backfire-B' of the naval AV-MF, which has about 120 of the 255 in service in late 1984. This example is shown carrying an AS-4 'Kitchen' supersonic cruise missile, but later missiles are now about to enter service on 'Backfires' and 'Bears'.

Like several other Soviet aircraft, the Tu-22 supersonic bomber was deficient in range/payload, and a clear candidate for being modified with the TsAGI-developed partial swing-wing, only the outer wings being pivoted. The resulting **Tupolev Tu-22M** probably first flew at Kazan in 1969 and a small number entered service in the early 1970s. In turn this led to an aircraft believed to be the **Tu-26**, and called **'Backfire-B'** by NATO. This has a completely revised fuselage with the engines installed conventionally in the rear fuselage fed by extremely large ducts from variable inlets on the sides of the forward fuselage, and with the bogie main gears folding inwards into the fuselage. By 1983 about 220 of the improved aircraft were in service, divided equally between DA (strategic aviation) and AV-MF (naval aviation). Many have been seen with various armament schemes, and these aircraft pose a severe threat to all ships within about 3220 km (2,000 miles) of Soviet bases. With inflight-refuelling to an overload weight after take-off, direct missions could be flown against the USA, though with the Soviet Union's gigantic ICBM force this is unnecessary and bombers are used entirely against moving targets. Production is continuing at about 42 per year, while in 1984-5 the much larger bomber called Ram-P 'Blackjack' is expected to enter service.

Specification
Tupolev Tu-26 'Backfire-B'

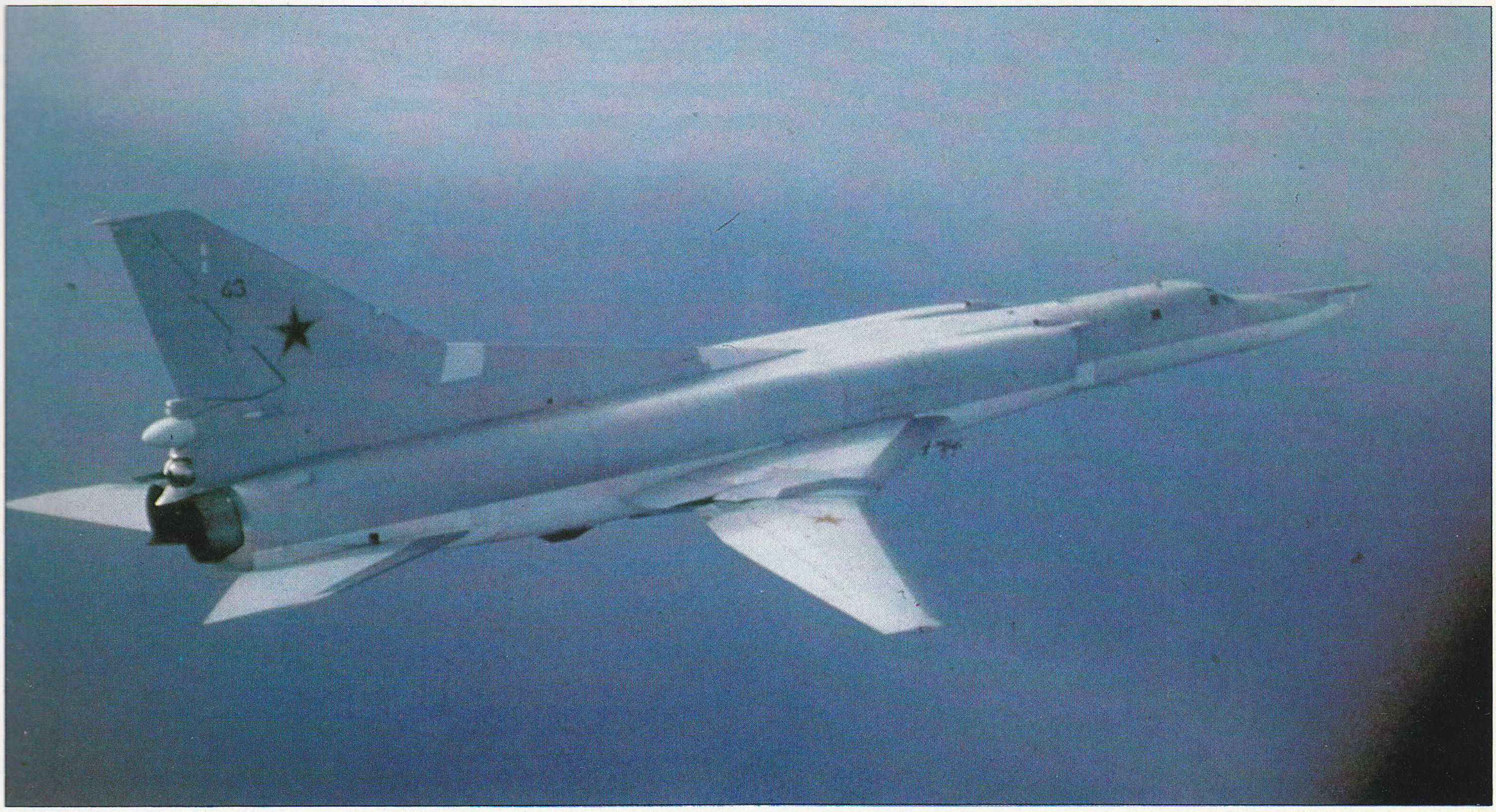
Type: strategic attack and reconnaissance aircraft

Powerplant: believed two 20000-kg (44,092-lb) thrust Kuznetsov NK-144 augmented turbofans

Performance: maximum speed, clean at high altitude about 1915 km/h (1,190 mph) or Mach 1.8; radius on a hi-lo-hi mission with maximum bombload about 3220 km (2,000 miles)

Weights: empty about 47175 kg (104,003 lb); maximum take-off 111130 kg (245,000 lb)

Dimensions: span (55°) 34.45 m (113 ft 0.3 in), and (20°) 26.0 m (85 ft 3.5 in); length 40.0 m (131 ft 2.8 in); height 10.0 m (32 ft 9.75 in); wing area 166.0 m^2 (1,786.9 sq ft)



Taken by a Swedish fighter, for which the 'Backfire' was deliberately posed, this photograph shows the highly loaded wings spread out in the cruise position. The twin 23-mm tail cannon are remotely directed by radar, and extremely comprehensive ECM is installed.

USSR

Tupolev (?) 'Blackjack'

On 25 November 1981 an American reconnaissance satellite sensor transmitted a poor linescan picture showing a large variable-sweep bomber parked on the Ramenskoye test centre near Moscow. From two Tu-144s parked nearby it was possible to see that the new aircraft was much larger than the Tupolev Tu-22M 'Backfire', and also much larger than the Rockwell B-1, though in many respects it is extremely similar to the USAF bomber. The new bomber is assumed in the West to have been designed at the Tupolev bureau, though even this cannot yet be confirmed, and the NATO reporting name is **'Blackjack'**.

Biggest, heaviest and most powerful combat aircraft in history, though certainly much slower than the stillborn North American XB-70 (which had roughly the same engine power), the 'Blackjack' obviously has tremendous range with very heavy weapon loads, and unquestionably encompasses the whole of North America from bases within the Soviet Union without even needing much inflight-refuelling. Penetration of defended airspace would certainly have to be at the lowest safe altitude, with the wings fully swept and probably with an automatic ride control using active flight-control surfaces. There is no likelihood of any major commonality with the existing 'Backfire', though the two types may carry similar types of weapon. The big unknown is how far the Soviet electronics and other electromagnetic-wavelength engineers have progressed along the road to an unobservable 'stealth' aircraft, which is the key to the survivability of this monster bomber in any future conflict.

Specification (estimated)
Tupolev (?) 'Blackjack'

Type: long-range strategic bomber and missile carrier

Powerplant: four large augmented turbofans (possibly derived from the 20000-kg/44,092-lb thrust Kuznetsov NK-144 used in the Tu-144)

Performance: maximum speed, clean at high altitude 2225 km/h (1,383 mph); unrefuelled combat radius (conditions not stated by US Department of Defense) 7300 km (4,536 miles)

Weights: empty about 90000 kg (198,416 lb); maximum take-off 260800 kg (574,966 lb)

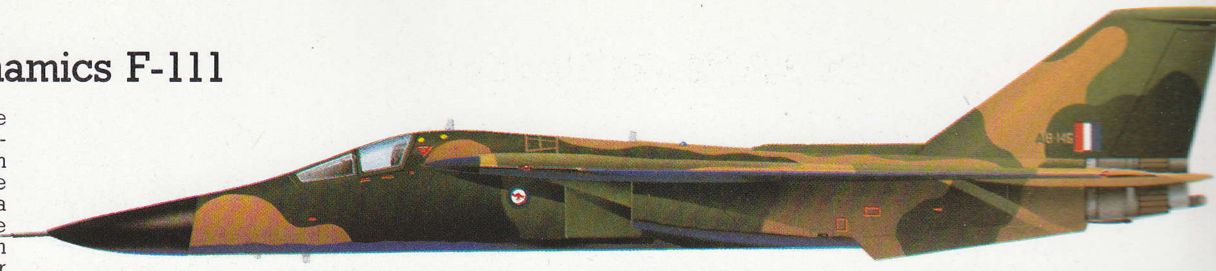
Dimensions: span (spread) 45.75 m (150 ft); length 55.00 m (180 ft); height 13.75 m (45 ft)

Armament: weapon load of 16330-22680 kg (36,000-50,000 lb), including all known Soviet strategic nuclear weapons and the new AS-X-15 standoff missile

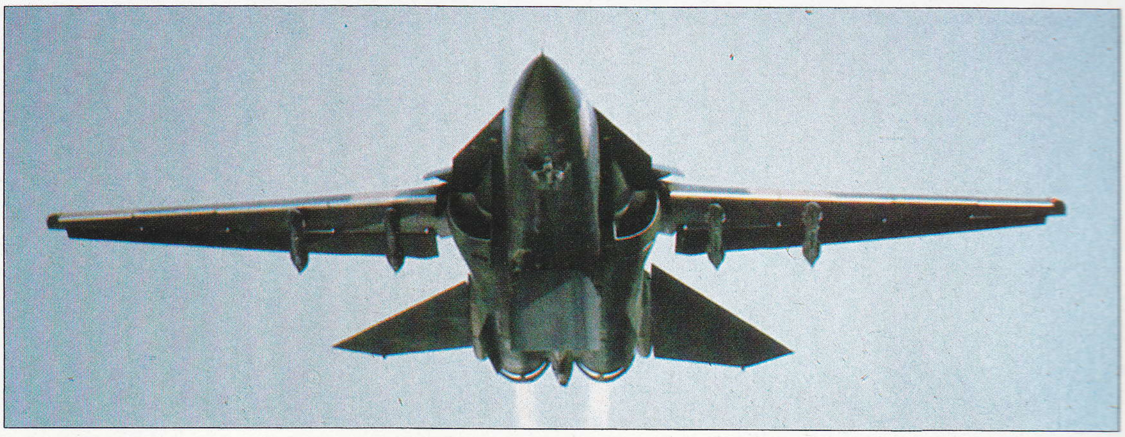
USA

General Dynamics F-111

The specification by the US Air Force for a TFX (tactical fighter experimental) in 1960 demanded such long range that the final aircraft came out far too large to be effective as a fighter, but it found its true role as the world's first attack aircraft with both supersonic speed and avionics for blind first-pass attack on a point target. Winning over a Boeing-Wichita rival, the **General Dynamics F-111** flew on 21 December 1964, featuring for the first time in a production type variable-sweep 'swing wings', augmented turbofan engines and terrain-following radar. Pilot and navigator are side-by-side in a jettisonable capsule which can serve as a boat or survival shelter. The large main-gear tyres are suited to rough strips but are so located that fuselage stores are limited to an ECM pod, apart from a small weapon bay which can carry a gun. In the **F-111C** for the RAAF and **FB-111A** for SAC the wings have greater span and the gear is strengthened for greater gross weights. Thanks to enormous internal fuel (usually 19010 litres/4,182 Imp gal) range exceeds that of any other TAC type, but problems with engines, inlet ducts and avionics resulted in successive sub-types such as the **F-111A** (141 built), **F-111D** (96, advanced but costly avionics), **F-111E** (94) and **F-111F** (106, greater power and optimized avionics). SAC received 76 FB-111s, serving in two wings with normal load of two B43 bombs or two SRAM missiles internally plus up to four SRAMs externally. Grumman, partner on the defunct US Navy F-111B, is rebuilding 42 F-111As as **EF-111A Raven** electronic-warfare platforms.



The F-111C version for the RAAF has low-thrust TF30 engines but the long-span wing as fitted to the FB-111A. Four of them have been modified to carry a multi-sensor reconnaissance pack, though they would not normally fly both reconnaissance and attack in the same mission.



Afterburner take-off by a USAF F-111 carrying four empty MERs (multiple ejector racks). The only stores carried on the fuselage are ECM pods.

Specification

General Dynamics F-111F

Type: all-weather interdiction aircraft

Powerplant: two 11385 kg (25,100 lb) thrust Pratt & Whitney TF30-100 augmented turbofans

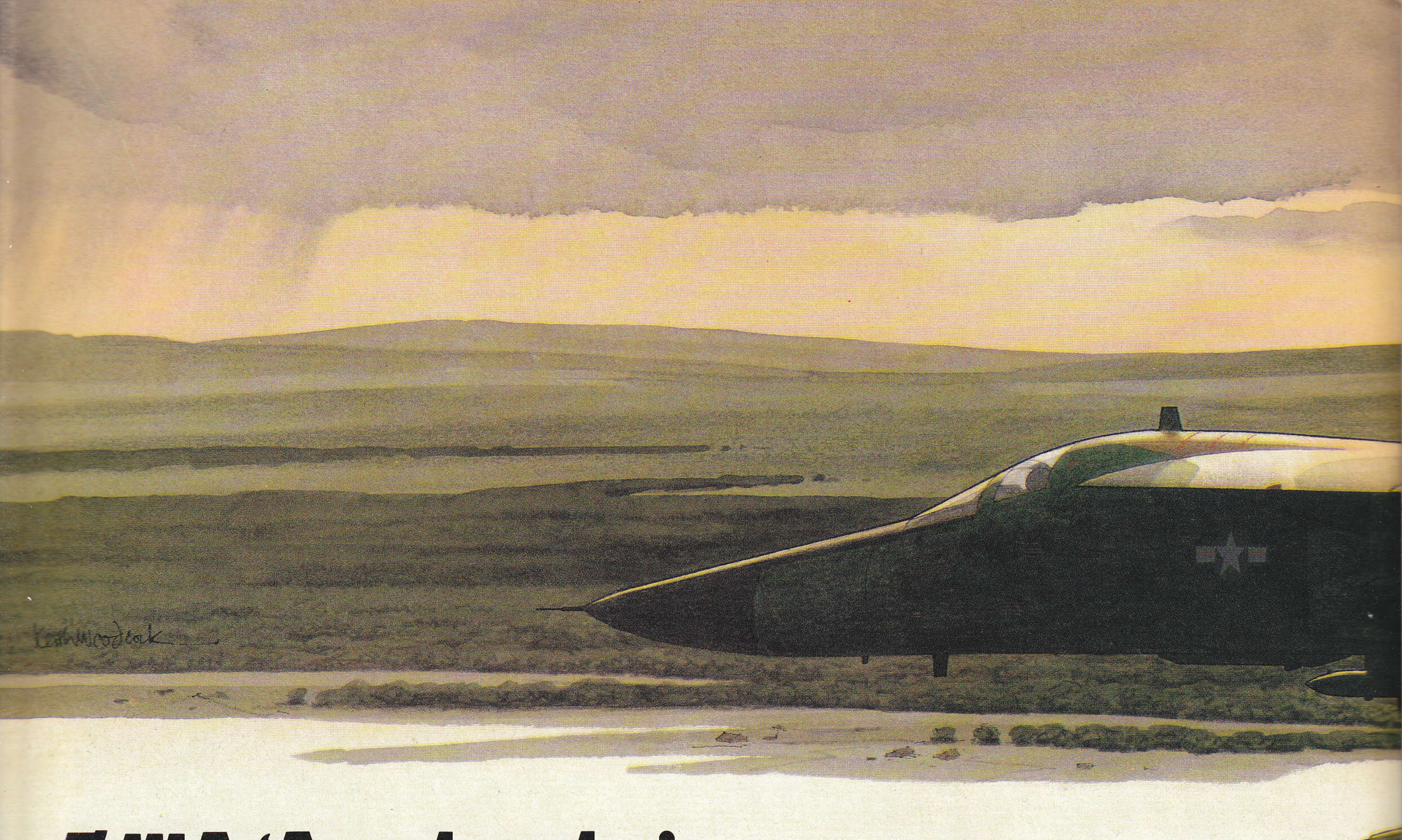
Performance: maximum speed, clean at 12190 m (40,000 ft) 2655 km/h (1,650 mph) or Mach 2.5; range at high altitude, clean with maximum internal fuel 4707 km (2,925 miles)

Weights: empty 21537 kg; (47,481 lb); maximum take-off 45359 kg (100,000 lb)

Dimensions: span (wings spread) 19.20 m (63 ft 0 in); length 22.40 m (73 ft 6 in); height 5.22 m (17 ft 1.5 in); wing area 48.77 m^2 (525.0 sq ft)

Armament: internal bay for two B43 or other bombs or one bomb and one 20-mm M61 gun; six wing pylons for theoretical conventional load of 14288 kg (31,500 lb)

View from the right seat of an FB-111A of USAF Strategic Air Command as a companion takes on fuel from a KC-135 tanker. The technique is vital to FB-111As.



Thundering in with 'burners blazing, F-111A 67-113 lets go the very last load on Vietnam on 15 August 1973. Operating out of Takhli AB, the standard load comprised up to 24 bombs plus tandem ALQ-87 ECM jammer pods under the fuselage.

F-111A 'Aardvarks' against North Vietnam

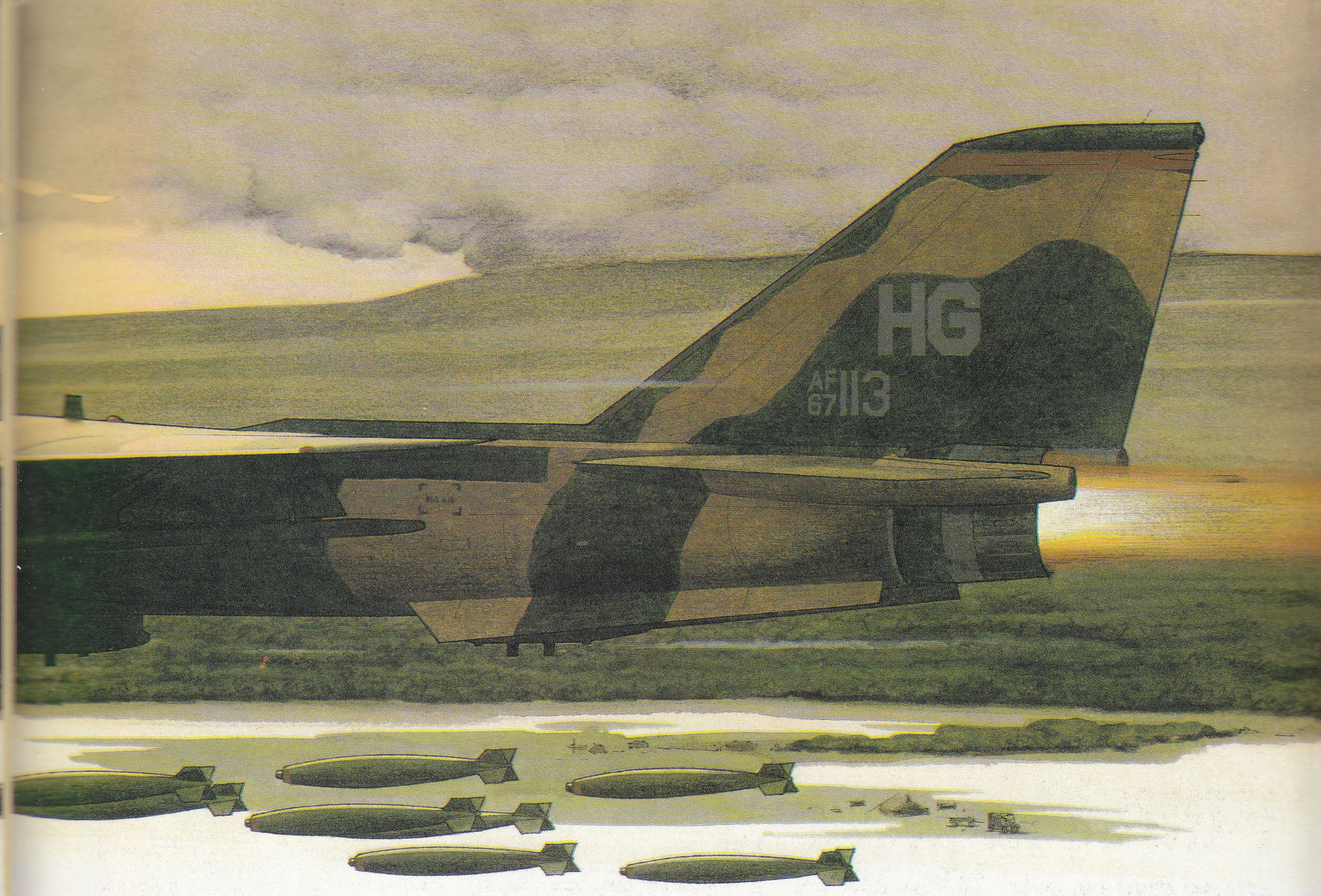
For the first 15-odd years from its introduction to service in 1967 the F-111 was the most advanced and unstoppable attack aircraft in the world. How ironic that, having already suffered terrible political, financial and technical difficulties, and a mauling from the media, this great aircraft should go into action and suffer disaster after disaster!

On 28 March 1968, in the first combat mission by a General Dynamics F-111A, an aircraft laden with two ALQ-87 jamming pods and 24 Mk 82 bombs lifted off from Takhli, Thailand, to assault a target in North Vietnam. This F-111A (66-0022) vanished forever. On 22 April 1968, another attempt was made to hurl the F-111A into battle. Now, another F-111A (68-0024) headed north, and also disappeared.

It was a grim and frightening start for Operation 'Combat Lancer', the US Air Force's controversial baptism of fire for the F-111. Under Colonel Ivan H. Dethman, cigar-smoking, tyre-kicking combat veteran, the 428th Tactical Fighter Squadron on 17 March 1968 had ferried six F-111As from Nellis AFB, Nevada, to Takhli where the strike aircraft were detached to the 355th Tactical Fighter Wing, then flying Republic F-105D Thunderchiefs in the campaign against North Vietnam known as 'Rolling Thunder'. As the men settled in amid the heat and red dust at Takhli, it was now more than a decade since the first studies aimed at developing the costly and trouble-prone F-111, seven years since Secretary of Defense Robert S. MacNamara had ballyhooed production of what was then perceived as the bi-service TFX multi-role strike craft, and four years since the maiden flight of the aeroplane on 21 December 1964. The F-111, so unloved that it was never assigned a popular name, dubbed 'Aardvark' by enthusiasts but not by crews, had failed totally and abysmally in the crucible of combat. Dethman's men, his ACs (aircraft commanders) and YOTs ('You over there!', the term for an F-111A weapon system officer) were demoralized by the unexplained loss of half their strike force, for by late April 1968, a third F-111A had travelled one-way into North Vietnam, and instead of proving that the aircraft design had merit, the theatre deployment had, instead, yielded gloom and doom.

It should not have been that way. Indeed, the F-111A seemed ideally constructed to deal punishing blows to the North Vietnamese. With its 6743-km (4,190-mile) range, it was the only strike aircraft able to carry a full load of ordn-

February 1968, and F-111A 67-0060 has just been delivered to the 429th TFS, seen on exercise over the Panamint Range. Within months, the 'Aardvarks' of a sister squadron, the 428th, were to be in action over the hostile skies of North Vietnam. After a tragic start, the F-111 was to prove its worth.



ance 'downtown' (to Hanoi) without inflight-refuelling. Its advanced Litton LND-21/A navigation and weapons delivery system permitted deep penetration by lone aircraft, without escort, with no back-up from tankers, ECM, AEW, or any other support planes, a 'lone wolf' capability matched in all the world only by the Grumman A-6A Intruder. The F-111A could carry up to 14424 kg (31,800 lb) of 'iron bombs' (usually the proximity-fused 227-kg/500-lb Mk 82 Snakeye) on a night or bad-weather, terrain-hugging mission deep into Ho Chi Minh's homeland. It was clearly an effective warplane, even if ACs and YOTs grumbled unceasingly about its unorthodox, side-by-side seating.

The number four symbolizes bad luck in Asian societies. On attempt number four, a 'Combat Lancer' crew strapped in, hurtled aloft from Takhli before dawn on 28 April 1968, and under radio silence bored north east toward a target in North Vietnam, thought to be the Hai Duong rail complex. Again, 24 Snakeyes hung from multiple ejector racks (MER) on the F-111A pylons while twin ALQ-87 jammer pods were ready to disrupt enemy radar transmissions. Again, two men in the unique forward-fuselage escape pod of the 'Aardvark' (which obviated the need for parachutes or ejection seats) were heading out on a lo-lo-lo, ground-skimming mission of the kind which had claimed three planes and six buddies.

This time, everything went like clockwork. The sophisticated navigation system of the F-111A permitted a ground-hugging, ultra-low-level mission rendering the strike aircraft invisible to North Vietnam's field-sweep radar. Endurance of the F-111A being so much greater than the F-105D or McDonnell F-4C, fuel consumption (although ravenous 'on the deck') was not a problem. The AC and YOT, relatively comfortable in their spacious cockpit, drove

The 428th TFS was to return to the Vietnamese skies for the bombing campaigns of 1972. Accompanied by the 430th TFS, it deployed to Udorn AB in Thailand, from where the 'Aardvarks' were to re-enter the battle. The first aircraft to arrive, shown here, was the harbinger of more than 4,000 of the most challenging bombing missions ever.

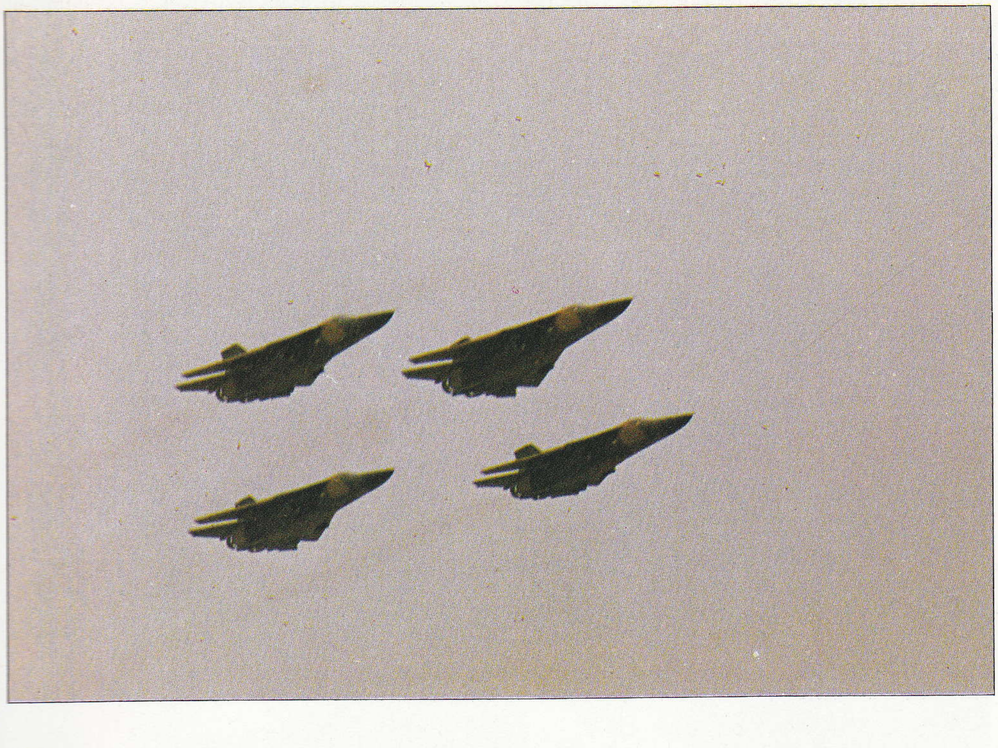
toward their target with radar homing and warning system (RHAWS) utterly silent, evidence that they were undetected. No AA fire, no SAMs, no MiGs, rose to challenge them. The two men were lugging a substantial payload at high subsonic cruise at treetop level against the heaviest defences the world had ever seen, and nobody seemed to know they were coming!

Some 51 more, equally successful missions were flown by Colonel Dethman's 'Combat Lancer' F-111As. After war's end, too late to help in 1968 planning, it became clear that abrupt tailplane failure caused by fatigue at a welding fault, not enemy action, threw the F-111A into an uncontrollable fatal manoeuvre. Dethman's force was withdrawn with the 31 October 1968 temporary bombing halt, and in 1969 all 'Aardvarks' were grounded to correct this flaw. But F-111s returned with a vengeance for the 1972 campaign against North Vietnam, called 'Linebacker'.

Captain Peter A. Messenies, F-111A pilot, recalls a mission to the outskirts of Hanoi where 'We were at an altitude of 250 feet (76.2 m) moving at Mach .87 in a region of odd-shaped ridges and peaks, and we were in clouds and haze for the final 14 minutes of our run-in to target . . .'

Though four F-111s were lost in combat in 1972 (67-0063, 67-0068, 67-0092, 67-0094) and one more in Laotian operations after war's end (67-0111), the never-very-popular 'Aardvark' had proved itself as a long-range strike aircraft with unmatched night/all-weather capability. F-111s assaulted fuel dumps, railyards, bridges. Some, under the 'Igloo White' programme, seeded enemy terrain with paradropped acoustic sensors which detected North Vietnamese troop movements. F-111As from the 428th and 430th Tactical Fighter Squadrons supported the massive 'Christmas bombing' by Boeing B-52s in the Hanoi/Haiphong region in December 1972. These two squadrons flew 4,030 sorties in five months, mostly at low level in bad weather, and 2.5 million kg (5.5 million lb) of bombs were carried to enemy targets. Despite its poor beginning, the F-111 dealt out crippling punishment, helped force North Vietnam to a settlement, and (when overall mission sorties are counted) suffered fewer losses per combat hour than any other aircraft type of the South East Asia war.

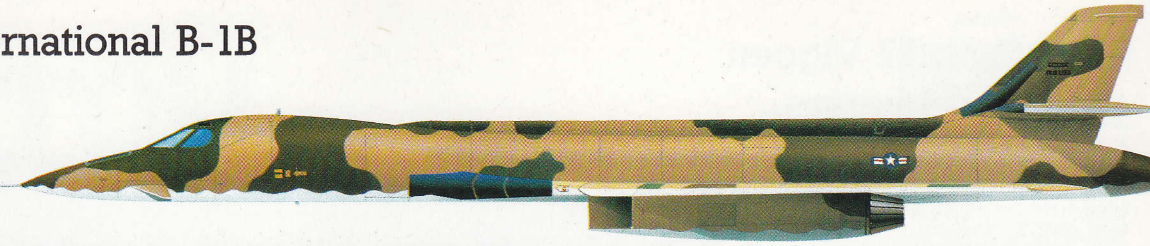
Pilot's view of companion aircraft heading for distant Thailand as the first aircraft of the 428th TFS head out from Nellis in March 1968. 'Combat Lancer' was to see the introduction of an entirely new form of aerial warfare, with F-111s possessing the capability to undertake missions impossible to fly with less advanced aircraft.



Box four from the 428th TFS fly past with wings fully swept on arrival at Takhli AB on 17 March 1968, on the original Combat Lancer deployment. One-Elevens seldom fly tight formation, and these particular aircraft were to embark on their missions alone.

USA

Rockwell International B-1B



This B-1A prototype is shown with conventional ejection seats instead of a capsule, fixed inlets and other updates, but retains the dorsal spine and long pointed tailcone.

No aircraft in history has taken so long to mature as the **Rockwell B-1B**, which at last does seem likely to enter USAF service in 1985 and become combat ready in July 1987 as the replacement for the Boeing B-52. The latter has already had to soldier on several times longer than planned, and is costing increasingly more to update and still falling short on penetrative capability. The original **B-1A**, first flown in December 1974, was a Mach-2 high-altitude nuclear bomber, with limited low-level conventional-warfare capability. The B-1B, which looks much the same, is designed to fly at low level on terrain-following radar, with extremely heavy loads of varied weapons, and to use the world's most comprehensive avionic systems for navigation, weapon delivery and, in particular, protection against hostile defence systems. Unlike the original four prototypes it will have plain fixed engine inlets, four ordinary ejection seats and no special provision for supersonic flight. Fuel capacity is greatly increased for global range even without refuelling, the weapon-bay bulkhead is movable for carriage of such long stores as the ALCM, and the structure is strengthened and specially designed and coated to reduce radar cross-section (apparent size on enemy radars) to one-tenth that of the B-1A, which itself was one-tenth that of a B-52H. It is planned to build 100, costing around $40,000 million, even though there is a prospect of an even less-visible Northrop 'stealth' bomber from the early 1990s.

Specification

Rockwell International B-1B

Type: strategic bomber

Powerplant: four 13563-kg (29,900-lb) thrust General Electric F101-102 augmented turbofans

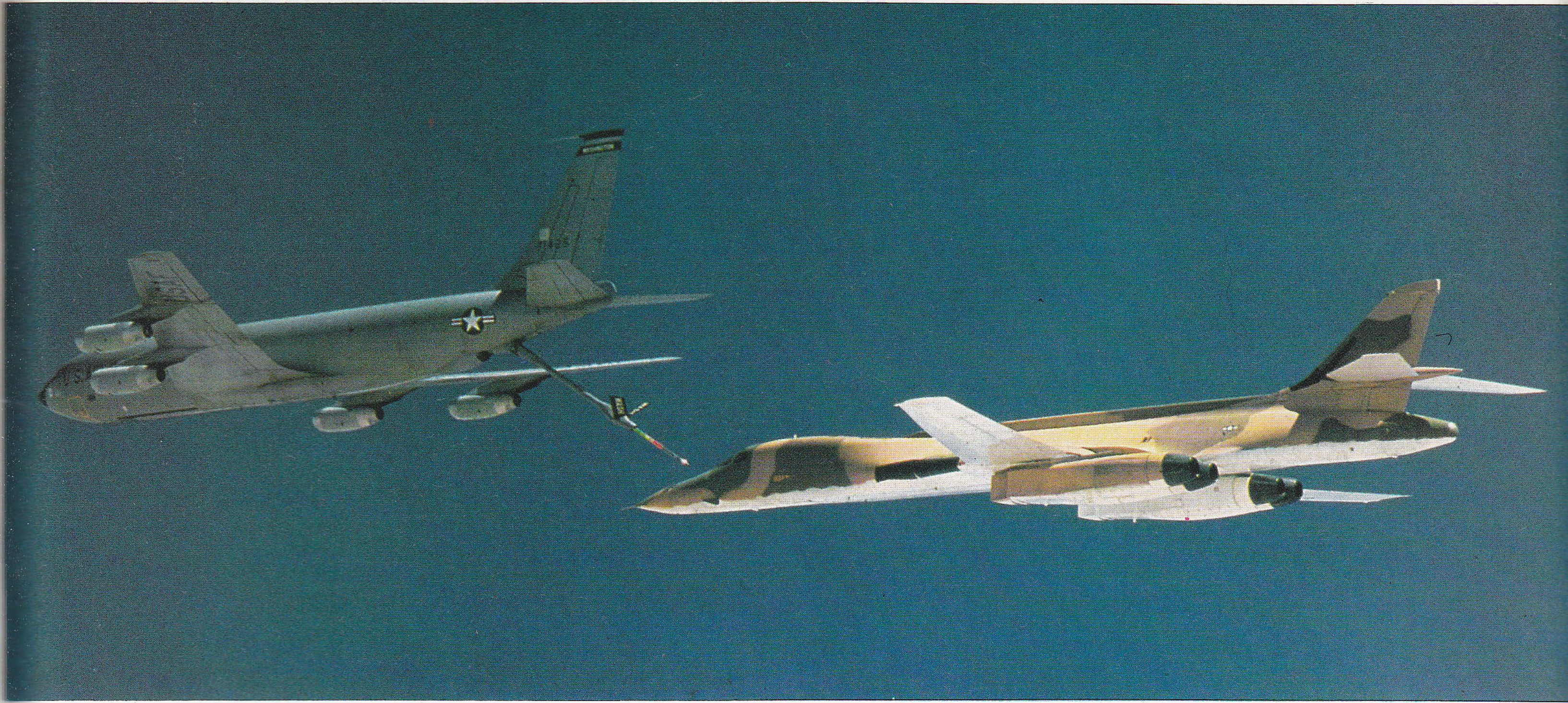
Performance: maximum speed, clean at 152 m (500 ft) 1207 km/h (750 mph) or Mach 0.99; range with maximum internal fuel, maximum missile load and unrefuelled over 11265 km (7,000 miles)

Weights: empty 72575 kg (160,000 lb); maximum take-off 216364 kg (477,000 lb)

Dimensions: span variable 23.84 to 41.67 m (78 ft 2.5 in to 136 ft 8.5 in); length 45.78 m (150 ft 2.5 in); height 10.24 m (33 ft 7.25 in); wing area 181.2 m^2 (1,950.0 sq ft)

Armament: eight ALCM internally plus 14 externally, or 24 SRAM internally plus 14 externally, or 12 B28 or B43 nuclear bombs internally plus 8/14 externally, or 24 internal and 14 external B61 or B83 nuclear bombs, or 36287 kg (80,000 lb) of conventional bombs

The fourth B-1A prototype is air-refuelled by an Air National Guard KC-135A. In fact it was the second B-1A that was brought up most closely to B-1B standard, the most externally obvious change being removal of the long dorsal spine.



ISRAEL

IAI Lavi

Fortified by its successful development of the Nesher and then the largely IAI-designed Kfir fighters, the Israeli aircraft industry (IAI) agreed in 1976 to consider the daunting task of creating a completely new multi-role combat aircraft for use in the 1990s. The **IAI Lavi** (young lion) is being developed to meet the need of the Israeli air force for a new-technology aircraft configured primarily for tactical attack missions, to replace first the McDonnell Douglas A-4 Skyhawk and later the Kfir. At first it was expected a collaborative deal would be reached either with another country embarking on a similar project or, as a paid subcontract, with a US company. In the event, while Pratt & Whitney has an intense interest in collaborating on the propulsion, the only major subcontract has gone to Grumman Aerospace, whose great experience in advanced composite structures is being used in the design and manufacture of the wing. The US company is to build wings for the first 20 aircraft.

Like most agile air-combat aircraft of today, the Lavi has a canard foreplane, swept back and close-coupled to the wing (and remarkably in line with the pilot's seat). A ventral inlet is used, ahead of the nose landing gear, the main gears also retracting into the fuselage. A turbojet was selected for many reasons, and a very significant spin-off of the engine choice is that Israel is one of the largest operators of the McDonnell Douglas F-4 Phantom, for which the PW1120 engine conversion is being aggressively marketed by Boeing which hopes to re-engine several hundreds of Phantoms in many countries, Israel being the most likely launch customer. First flight of the Lavi is scheduled for 1986, and eventually IAI hopes to build 300 for the Israeli air force alone, including about 60 tandem trainer versions with full combat capability.

Specification

IAI Lavi

Type: single-seat tactical attack fighter

Powerplant: one Pratt & Whitney PW1120 afterburning turbojet with maximum rating of 9353-kg (20,620-lb) thrust

Performance: maximum speed at low level with eight M117 bombs 997 km/h (619 mph), or clean at high altitude 1964 km/h (1,220 mph); combat radius at low level with eight M117 bombs 452 km (281 miles)

Weights: empty 6760 kg (14,903 lb); normal loaded, clean 9664 kg (21,305 lb); maximum take-off 17010 kg (37,500 lb)

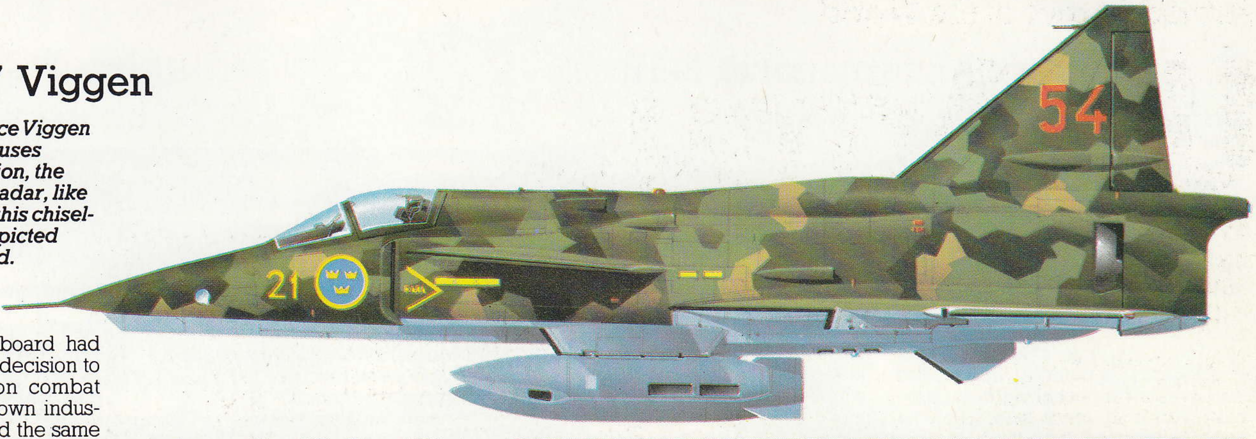
Dimensions: span 8.71 m (28 ft 7 in); length 14.39 m (47 ft 2.5 in); height 5.28 m (17 ft 4 in); wing area 32.5 m^2 (349.8 sq ft)

Armament: fuselage pylons for up to six bombs, and four wing pylons for missiles, bombs, rockets or other stores; Python or Sidewinder AAM rail at each wingtip

SWEDEN

Saab 37 Viggen

A Saab SF37 reconnaissance Viggen from wing F21, which also uses another multi-sensor version, the SH37. The latter has nose radar, like the attack AJ37 but unlike this chisel-nose machine, which is depicted with a Red Baron recon pod.



By 1960 the Swedish air board had once again taken the bold decision to procure a new-generation combat aeroplane from Sweden's own industry. As before it was agreed the same basic type should be developed for multiple roles, and on this occasion particular emphasis was wisely placed on the ability to operate away from known airfields. STOL capability was demanded, for safe operation from country roads, and this was achieved by selecting a giant rear wing and a large flapped canard, tandem-wheel main gears strong enough for no-flare landings, and a thrust reverser. The first **Saab 37** prototype flew on 8 February 1967, and the System 37 was subsequently developed as an integral part of Sweden's Stril 60 electronic defence system.

Several versions were subsequently produced for the Swedish air force (Flygvapen). First, and most numerous, was the **AJ37** attack variant. Even this initial model contains some 600 kg (1,323 lb) of special avionics, including a large Ericsson radar, comprehensive navaids, two quite different aids to blind landing and very advanced weapon-delivery systems and ECM, some of the latter being housed in external pods. Closely related versions were the SF37 and SH37 reconnaissance aircraft and SK37 dual trainer, production of these four sub-types together totalling 180. Since 1979 deliveries have continued of the completely revised JA37 interceptor, which also has considerable attack potential as a secondary role.

Specification

Saab AJ37 Viggen

Type: single-seat attack aircraft

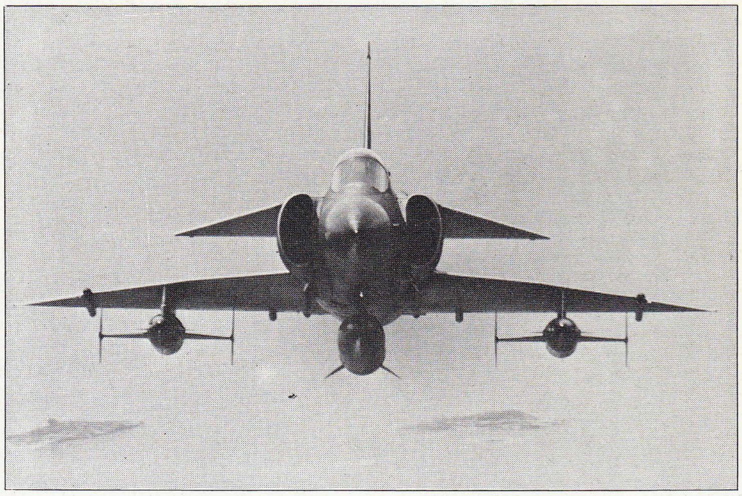
Powerplant: one Volvo Flygmotor RM8A augmented turbofan rated with maximum afterburner at 11800-kg (26,015-lb) thrust

Performance: maximum speed, clean Mach 1.2 at low level, and over Mach 2 (2130 km/h/1,323 mph) at high altitude; tactical radius with external weapons on a hi-lo-hi mission 1000 km (621 miles)

Weights: empty 11700 kg (25,794 lb); maximum take-off 20500 kg (45,195 lb)

Dimensions: span 10.60 m (34 ft 9.5 in); length 16.30 m (53 ft 5.7 in); height 5.80 m (19 ft 0.2 in); wing area (main wing) 46.0 m^2 (495.2 sq ft)

Armament: seven pylons (two more optional) for all types of bomb, rocket-launcher, gun pod and various missiles including Saab RB04E or RB05A, RB75 (Maverick) or RB24 Sidewinder or RB28 Falcon AAMs



Above: Head-on aspect of an AJ37 attack Viggen over the Baltic islands with two of the big RB04E anti-ship cruise missiles. The usual centreline store is a long-range fuel tank, which is also carried by reconnaissance Viggens.

Below: An AJ37 attack Viggen from wing F7, armed with four pods each housing six formidable 135-mm air/surface rockets. The curved grey rectangle on the side of the rear fuselage is a thrust-reverser outlet.

US Army

Part 7

Order of Battle

ARMY CHIEF OF STAFF

ARMY STAFF FIELD OPERATING AGENCIES

- Operational Test and Evaluation Agency, Falls Church, Va
- Ballistic Missile Defense Systems Command, Redstone Arsenal, Al
- Military Personnel Center, Alexandria, Va
- Recruiting Command, Fort Sheridan, Ill
- Military Academy, West Point, NY
- Army War College, Carlisle Barracks, Pa
- Army Nuclear and Chemical Agency, Fort Belvoir, Va
- Troop Support Agency, Fort Lee, Va
- Computer Systems Command, Fort Belvoir, Va
- Finance and Accounting Center, Fort Benjamin Harrison, Ind
- Reserve Components Personnel and Administration Center, St Louis, Mo
- Medical Research and Development Command, Fort Detrick, Md
- Development and Employment Agency, Fort Lewis, Washington

MATERIAL DEVELOPMENT AND READINESS COMMAND (DARCOM)

- Headquarters, Alexandria, Va
- Armament, Munitions and Chemical Command, Rock Island, Ill
- Aviation Systems Command, St Louis, Mo
- Chemical Research and Development Center, Aberdeen Proving Ground, Md
- Communications-Electronics Command, Fort Monmouth, NJ
- DARCOM-Europe, Seckenheim, Germany
- Depot System Command, Chambersburg, Pa
- Electronics R&D Command, Adelphi, Md
- Missile Command, Redstone Arsenal, Al
- Security Assistance Center, Alexandria, Va
- Tank-Automotive Command, Warren, Mich
- Test and Evaluation Command, Aberdeen Proving Ground, Md
- Troop Support Command, St Louis, Mo
- Logistics Management Center, Fort Lee, Va

FORCES COMMAND (FORSCOM)

- Headquarters, Fort McPherson, Ga
- First US Army, Fort Meade, Md
- Second US Army, Fort Gillem, Ga
- Third US Army, Fort McPherson, Ga
- Fifth US Army, Fort Sam Houston, Tx
- Sixth US Army, San Francisco, Ca
- I Corps, Fort Lewis, Wash
- 7th Infantry Division, Fort Ord, Ca
- 9th Infantry Division, Fort Lewis, Wash
- 172nd Infantry Brigade, Fort Richardson, Alaska
- III Corps, Fort Hood, Tx
- 1st Infantry Division (Mech), Fort Riley, Ka
- 1st Cavalry Division, Fort Hood, Tx
- 2nd Armored Division, Fort Hood, Tx
- 4th Infantry Division (Mech), Fort Carson, Colo
- 5th Infantry Division (Mech), Fort Polk, La
- 6th Cavalry (Air Combat) Brigade, Fort Hood, Tx
- 3rd Armored Cavalry Regiment, Fort Bliss, Tx
- III Corps Artillery, Fort Sill, Ok
- XVIII Airborne Corps, Fort Bragg, NC
- 24th Infantry Division, Fort Stewart, Ga
- 82nd Airborne Division, Fort Bragg, NC
- 101st Airborne Division (Air Assault), Fort Campbell, Ky
- 194th Armored Brigade, Fort Knox, Ky
- 197th Infantry Brigade, Fort Benning, Ga
- 193rd Infantry Brigade, Fort Clayton, Panama
- 18th Field Artillery Brigade, Fort Bragg, NC
- 75th Field Artillery Brigade, Fort Sill, Ok
- 212th Field Artillery Brigade, Fort Sill, Ok
- 214th Field Artillery Brigade, Fort Sill, Ok
- 1st Special Operations Command, Fort Bragg, NC
- 5th Special Forces Group (Airborne), Fort Bragg, NC
- 7th Special Forces Group (Airborne), Fort Bragg, NC
- 10th Special Forces Group (Airborne), Fort Devens, Mass
- 4th Psychological Operations Group, Fort Bragg, NC
- 11th Air Defense Artillery Group, Fort Bliss, Tx
- Army Readiness and Mobilization Region II, Fort Dix, NJ
- Army Readiness and Mobilization Region V, Fort Sheridan, Ill
- Army Readiness and Mobilization Region VI, Fort Knox, Ky
- Army Readiness and Mobilization Region VII, Fort Sam Houston, Tx
- Army Readiness and Mobilization Region VIII, Fitzsimons Army Medical Center, Colo
- Army Readiness and Mobilization Region IX, Presidio of San Francisco, Ca
- National Training Center, Fort Irwin, Ca
- Training Centers
  - Fort Devens, Mass
  - Fort Drum, NY
  - Fort Indiantown Gap, Pa
  - Fort McCoy, Wis
  - Fort McPherson, Ga
  - Fort Meade, Md
  - Fort Sam Houston, Tx
  - Presidio of San Francisco, Ca
  - Fort Sheridan, Ill

Now in producton at a rate of 60 tanks a month, the M1 Abrams has proved popular with the 7th Army in Germany. More reliable than the M60 it is replacing, as well as being exceptionally mobile, it will also have its 105-mm gun replaced by the excellent German 120-mm smooth-bore gun.

WESTERN COMMAND (WESTCOM)

- Headquarters, Fort Shafter, HI
- 25th Infantry Division, Schofield Barracks, HI
- Support Command, Fort Shafter, HI
- 45th Support Group, Schofield Barracks, HI

TRAINING AND DOCTRINE COMMAND (TRADOC)

- Headquarters, Fort Monroe, Va
- Combined Arms Center, Fort Leavenworth, Ka
- Logistics Center, Fort Lee, Va
- Soldier Support Center, Fort Benjamin Harrison, Ind
- Combat Developments Experimentation Center, Fort Ord, Ca
- Combined Arms Test Activity, Fort Hood, Tx
- Systems Analysis Activity, White Sands Missile Range, NM
- Training Support Center, Fort Eustis, Va
- First ROTC Region, Fort Bragg, NC
- Second ROTC Region, Fort Knox, Ky
- Third ROTC Region, Fort Riley, Ka
- Fourth ROTC Region, Fort Lewis, Wash
- Training Centers
  - Fort Benning, Ga
  - Fort Bliss, Tx
  - Fort Dix, NJ
  - Fort Gordon, Ga
  - Fort Jackson, SC
  - Fort Knox, Ky
  - Fort Leonard Wood, Mo
  - Fort McClellan, Al
  - Fort Sill, Ok
- Schools and Centers
  - Air Defense Center and School, Fort Bliss, Tx
  - Armor Center and School, Fort Knox, Ky
  - Aviation Center, Fort Rucker, Al
  - Chaplain Center and School, Fort Monmouth, NJ
  - Command and General Staff College, Fort Leavenworth, Ka
  - Defense Information School, Fort Benjamin Harrison, Ind
  - Defense Language Institute Foreign Languge Center, Presidio of Monterey, Ca
  - Engineer Center and School, Fort Belvoir, Va
  - Field Artillery Center and School, Fort Sill, Ok
  - Infantry Center and School, Fort Benning, Ga
  - Institute of Personnel and Resource Management, Fort Benjamin Harrison, Ind
  - Intelligence Center and School, Fort Huachuca, Ar
  - Intelligence School, Fort Devens, Mass
  - Judge Advocate General's School, Charlottesville, Va
  - Missile and Munitions Center and School, Redstone Arsenal, Al
  - Ordnance Center and School, Aberdeen Proving Ground, Md
  - Organizational Effectiveness Training Center, Fort Ord, Ca
  - Quartermaster Center/School, Fort Lee, Va
  - Sergeants Major Academy, Fort Bliss, Tx
  - Signal Center and School, Fort Gordon, Ga
  - 1st Special Warfare Center, Fort Bragg, NC
  - Transportation Center and School, Fort Eustis, Va

ARMY INTELLIGENCE AND SECURITY COMMAND (USAINSCOM)

- Arlington Hall Station, Va

BELLIGERENT

Firing a 95.2-kg (210-lb) shell to a range of 21 km (13 miles) and with a new round planned to reach 29 km (18 miles), the M110A2 has replaced the M107 and M110. Gun crew well wrapped up against the cold, 'Belligerent' is seen here on exercise in Korea, March 1984.

Still soldiering on, the M48A5 is the last of the M48 series still in front-line US service, equipping the two US armoured battalions in South Korea.

COMMUNICATIONS COMMAND (USACC)

Headquarters, Fort Huachuca, Ar
5th Signal Command (Europe), Worms, Germany
7th Signal Command (CONUS), Fort Ritchie, Md
Communications-Electronics Engineering Installation Agency, Fort Huachuca, Ar
Communications Systems Agency, Fort Monmouth, NJ
1st Signal Brigade, Seoul, Korea
11th Signal Brigade, Fort Huachuca, Ar

CRIMINAL INVESTIGATION COMMAND (USACIDC)

Falls Church, Va

CORPS OF ENGINEERS (USACE)

Headquarters, Washington DC
Europe Division, Frankfurt, West Germany
Huntsville Division, Huntsville, Al
Lower Mississippi Valley Division, Vicksburg, Miss
Middle East Division, Riyadh, Saudi Arabia
Missouri River Division, Omaha, Neb
New England Division, Waltham, Mass
North Atlantic Division, New York, NY
North Central Division, Chicago, Ill
North Pacific Division, Portland, Or
Ohio River Division, Cincinnati, Oh
Pacific Ocean Division, Honolulu, HI
South Atlantic Division, Atlanta, Ga
South Pacific Division, San Francisco, Ca
Southwestern Division, Dallas, Tx
Missile Construction Office, San Francisco, Ca

HEALTH SERVICES COMMAND (HSC)

Headquarters, Fort Sam Houston, Tx
Brooke Army Medical Center, Fort Sam Houston, Tx
Dwight David Eisenhower Army Medical Center, Fort Gordon, Ga
Fitzsimons Army Medical Center, Aurora, Co
Letterman Army Medical Center, Presidio of San Francisco, Ca
Madigan Army Medical Center, Tacoma, Wash
Tripler Army Medical Center, HI
Walter Reed Army Medical Center, Washington DC
William Beaumont Army Medical Center, El Paso, Tx
Academy of Health Sciences, Fort Sam Houston, Tx
Army Aeromedical Center, Fort Rucker, Al
Army Environmental Hygiene Agency, Aberdeen Proving Ground, Md
US Army Garrison, Fort Detrick, Md

MILITARY TRAFFIC MANAGEMENT COMMAND (MTMC)

Headquarters, Washington DC
Eastern Area, Bayonne, NJ
Western Area, Oakland Army Base, Ca
Transportation Terminal Command, Europe, Rotterdam, Netherlands

MILITARY DISTRICT OF WASHINGTON (MDW)

Fort Lesley J. McNair, Washington DC

US ARMY EUROPE (USAREUR)

Headquarters, USAREUR and Seventh US Army, Heidelberg
V Corps, Frankfurt-am-Main
3rd Armored Division, Frankfurt-am-Main
8th Infantry Division (Mech), Bad Kreuznach
4th Brigade, 4th Infantry Division (Mech), Wiesbaden
11th Armored Cavalry Regiment, Fulda
V Corps Artillery, Frankfurt-am-Main
VII Corps, Stuttgart
1st Armored Division, Ansbach
3rd Infantry Division (Mech), Würzburg
1st Infantry Division (Forward), Goppingen
2nd Armored Cavalry Regiment, Nürnberg
VII Corps Artillery, Stuttgart
2nd Armored Division (Forward), Garlstedt
Southern European Task Force
2nd Support Command (Corps)
3rd Support Command (Corps)
21st Support Command
32nd Air Defense Command, Darmstadt
1st Personnel Command
7th Medical Command
Seventh Army Training Command
US Command Berlin
Berlin Brigade
17th Field Artillery Brigade, Augsburg
41st Field Artillery Brigade, Babenhausen
42nd Field Artillery Brigade, Giessen
56th Field Artillery Brigade, Swäbisch-Gmünd
72nd Field Artillery Brigade, Wertheim
210th Field Artillery Brigade, Herzogenaurach
4th Transportation Brigade
18th Engineer Brigade
22nd Signal Brigade
59th Ordnance Brigade

EIGHTH US ARMY (EUSA)

Headquarters, Seoul
Combined Field Army (ROK/US), Seoul
2nd Infantry Division, Camp Casey
19th Support Command

US ARMY, JAPAN (USARJ)

Headquarters
IX Corps

MAJOR ARMY RESERVE COMMANDS

63rd Army Reserve Command, Los Alamitos, Ca
77th Army Reserve Command, Fort Toten, NY
79th Army Reserve Command, Willow Grove, Pa
81st Army Reserve Command, East Point, Ga
83rd Army Reserve Command, Colombus, Oh
86th Army Reserve Command, Forest Park, Ill
88th Army Reserve Command, Fort Snelling, Minn
89th Army Reserve Command, Wichita, Kan
90th Army Reserve Command, San Antonio, Tx
94th Army Reserve Command, Hanscom AFB, Mass
96th Army Reserve Command, Fort Douglas, Utah
97th Army Reserve Command, Fort Meade, Md
99th Army Reserve Command, Oakdale, Pa
102nd Army Reserve Command, St Louis, Mo
120th Army Reserve Command, Fort Jackson, SC
121st Army Reserve Command, Birmingham, Al
122nd Army Reserve Command, Little Rock, Ark
123rd Army Reserve Command, Fort Benjamin Harrison, Ind
124th Army Reserve Command, Fort Lawton, Wash
IX Corps (Augmentation), Fort deRussy, HI
70th Division (Training), Livonia, Mich
76th Division (Training), West Hartford, Conn
78th Division (Training), Edison, NJ
80th Division (Training), Richmond, Va
84th Division (Training), Milwaukee, Wis
85th Division (Training), Chicago, Ill
91st Division (Training), Sausalito, Ca
95th Division (Training), Midwest City, Ok
98th Division (Training), Rochester, NY
100th Division (Training), Louisville, Ky
104th Division (Training), Vancouver Barracks, Wash
108th Division (Training), Charlotte, NC
157th Infantry Brigade (Separate) (Mech), Horsham, Pa
187th Infantry Brigade (Separate), Fort Devens, Mass
205th Infantry Brigade (Separate), Fort Snelling, Minn
428th Field Artillery Brigade, South Bend, Ind
434th Field Artillery Brigade, Chicago, Ill
479th Field Artillery Brigade, Pittsburgh, Pa
75th Maneuver Area Command, Houston, Tx
87th Maneuver Area Command, Birmingham, Al
2nd Hospital Center, Hamilton Field, Ca
8th Medical Brigade, Fort Hamilton, NY
30th Hospital Center, Fort Sheridan, Ill
103rd Corps Support Command, Des Moines, Id
143rd Transportation Brigade, Orlando, Fla
220th Military Police Brigade, Gaithersburg, Md
221st Military Police Brigade, San Jose, Ca
290th Military Police Brigade (POW), Nashville, Tenn
300th Military Police Command (POW), Inkster, Mich
310th Theater Army Area Command, Fort Belvoir, Va
311th Corps Support Command, Los Angeles, Ca
351st Civil Affairs Command, Mountain View, Ca
352nd Civil Affairs Command, Riverdale, Md
353rd Civil Affairs Command, Bronx, NY
377th Theater Army Area Command, New Orleans, La
411th Engineer Brigade, Brooklyn, NY
412th Engineer Command, Vicksburg, Miss
416th Engineer Command, Chicago, Ill
420th Engineer Brigade, Bryan, Tx
425th Transportation Brigade, Fort Sheridan, Ill
804th Hospital Center, Bedford, Mass
807th Medical Brigade, Seagoville, Tx
818th Hospital Center, Fort Gillem, Ga
2290th Army Hospital, Rockville, Md
2291st Army Hospital, Columbus, Oh
5501st Army Hospital, Fort Snelling, Minn
7581st USAR Garrison, Fort Buchanan, PR

NATIONAL GUARD UNITS

26th Infantry Division, Boston, Mass
28th Infantry Division, Harrisburg, Pa
38th Infantry Division, Indianapolis, Ind
40th Infantry Division (Mech), Long Beach, Ca
42nd Infantry Division, New York, NY
47th Infantry Division, St Paul, Minn
49th Armored Division, Austin, Tx
50th Armored Division, Somerset, NJ
29th Infantry Brigade, Honolulu, HI
30th Separate Infantry Brigade (Mech), Clinton, NC
32nd Separate Infantry Brigade (Mech), Milwaukee, Wis
33rd Separate Infantry Brigade, Chicago, Ill
39th Separate Infantry Brigade, Little Rock, Ar
41st Infantry Brigade, Portland, Or
45th Separate Infantry Brigade, Edmond, Ok
48th Infantry Brigade (Mech), Macon, Ga
53rd Separate Infantry Brigade, Tampa, Fla
58th Separate Infantry Brigade, Baltimore, Md
67th Separate Infantry Brigade (Mech), Lincoln, Neb
69th Separate Infantry Brigade (Mech), Topeka, Kan
73rd Separate Infantry Brigade, Columbus, Oh
81st Separate Infantry Brigade (Mech), Seattle, Wash
92nd Separate Infantry Brigade, San Juan, PR
116th Separate Infantry Brigade, Staunton, Va
218th Separate Infantry Brigade (Mech), Newberry, SC
256th Infantry Brigade (Mech), Lafayette, La
207th Infantry Group (Scout), Anchorage, Alaska
30th Separate Armored Brigade, Jackson, Tenn
31st Separate Armored Brigade, Tuscaloosa, Al
149th Separate Armored Brigade, Louisville, Ky
155th Separate Armored Brigade, Tupelo, Miss
107th Armored Cavalry Regiment, Cleveland, Oh
116th Armored Cavalry Regiment, Twin Falls, Id
163rd Armored Cavalry Regiment, Bozeman, Mont
278th Armored Cavalry Regiment, Knoxville, Tenn
XI Corps Artillery, Salt Lake City, Utah
45th Field Artillery Brigade, Enid, Ok
57th Field Artillery Brigade, Whitefish Bay, Wis
103rd Field Artillery Brigade, Providence, RI
113th Field Artillery Brigade, Greensboro, NC
115th Field Artillery Brigade, Cheyenne, Wy
118th Field Artillery Brigade, Savannah, Ga
130th Field Artillery Brigade, Hutchinson, Kan
135th Field Artillery Brigade, Sedalia, Mo
138th Field Artillery Brigade, Lexington, Ky
142nd Field Artillery Brigade, Fayetteville, Ark
147th Field Artillery Brigade, Pierre, SC
151st Field Artillery Brigade, Sumter, SC
153rd Field Artillery Brigade, Glendale, Ariz
169th Field Artillery Brigade, Aurora, Colo
196th Field Artillery Brigade, Chattanooga, Tenn
197th Field Artillery Brigade, Manchester, NH
209th Field Artillery Brigade, Rochester, NY
224th Field Artillery Brigade, Sandston, Va
227th Field Artillery Brigade, Miami, Fla
631st Field Artillery Brigade, Grenada, Miss
111th Air Defense Artillery Brigade, Albuquerque, NM
16th Engineer Brigade, Columbus, Oh
30th Engineer Brigade, Charlotte, NC
35th Engineer Brigade, St Louis, Mo
194th Engineer Brigade, Nashville, Tenn
112th Medical Brigade, Worthington, Oh
175th Medical Brigade, Sacramento, Ca
213th Medical Brigade, Jackson, Miss
43rd Military Police Brigade, Providence, RI
49th Military Police Brigade, Alameda, Ca
261st Signal Command, Dover, Del
142nd Signal Brigade, Decatur, Al
228th Signal Brigade, Spartanburg, SC
167th Support Command, Birmingham, Al
213th Area Support Group, Allentown, Pa
184th Transportation Brigade, Laurel, Miss